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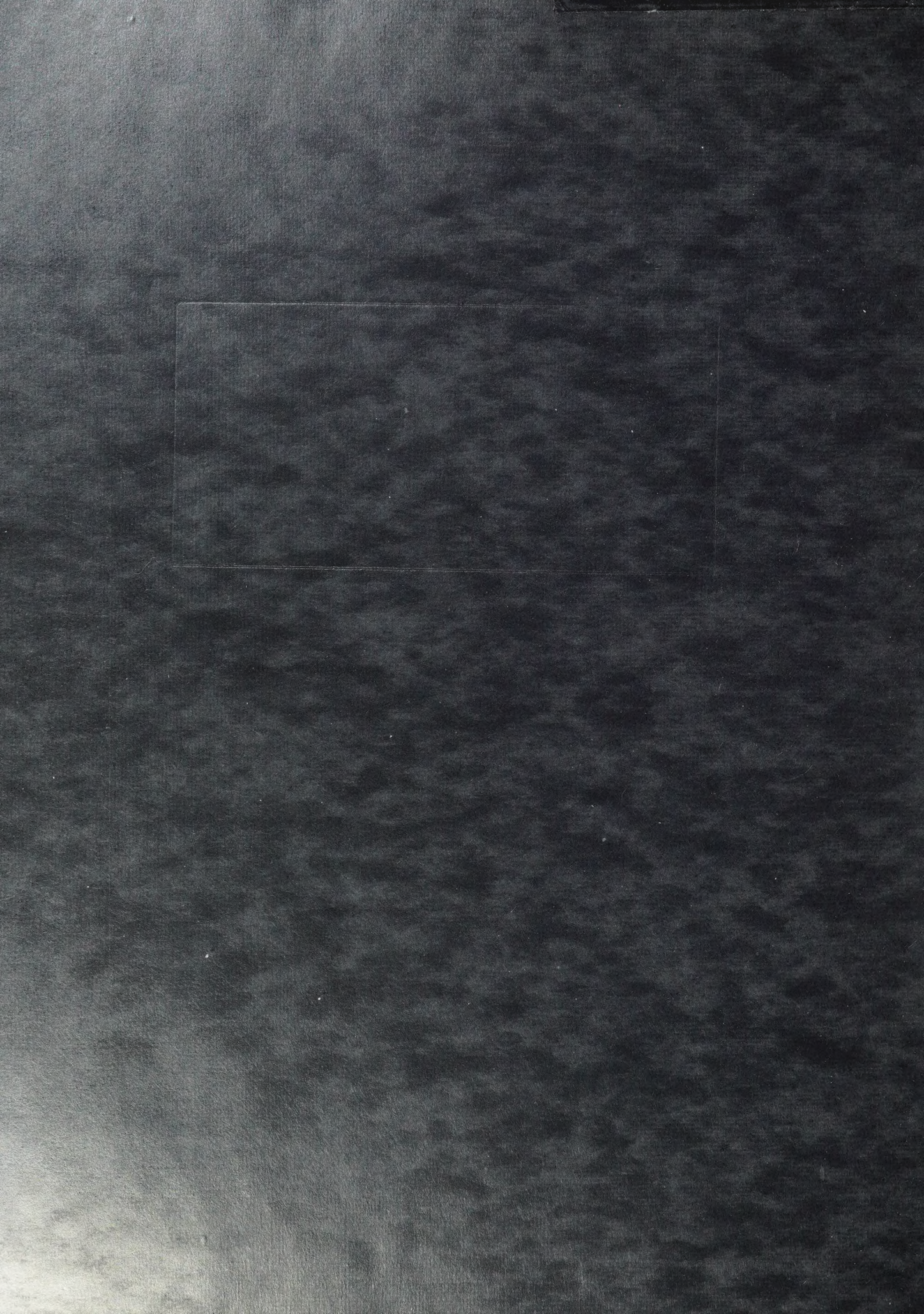
Monitoring Report On The Glanbrook Landfill Site

1984



ANNUAL OPERATIONAL MONITORING REPORT (1984)

FOR THE

REGIONAL LANDFILL SITE IN GLANBROOK

M O R R I S O N B E A T T Y L I M I T E D
4500 Dixie Road
Mississauga, Ontario
(416) 624-9308

APRIL, 1985
PROJECT NO. 386-841

N.J. RENNIE, B.E.S.
B.W. BEATTY, P.Eng.

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April 26, 1985

FILE NO. E309-09G
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Mr. R.F. Palombella
The Region of Hamilton-Wentworth
Department of Engineering
71 Main Street West
Hamilton, Ontario
L8N 3T4

Dear Mr. Palombella:

re: Annual Operational Monitoring Report (1984)
for the
Regional Landfill Site in Glanbrook
Your File No. E309-09G
Our File No. 386-841

We are pleased to submit to you the Annual Operational Monitoring Report (1984) for the Regional landfill site. The 1984 monitoring data has been included as extensions of previous years' tables and graphs. Recommendations have been made for future monitoring based on the interpretation of trends in the monitoring data.

Thank you for the opportunity of preparing this report.

Yours very truly,
MORRISON BEATTY LIMITED

Nancy J. Rennie

NJR/lf

Nancy J. Rennie, B.E.S.
Environmental Geomorphologist

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1.0 INTRODUCTION

We have prepared the 1984 Monitoring Report for the Regional landfill site in Glanbrook as requested by Mr. G.S. Spencer and Mr. G. Dykman of the Engineering Department, Regional Municipality of Hamilton-Wentworth. We have incorporated all monitoring data made available by the Region.

Monitoring of the landfill leachate, groundwater and surface water from Buckhorn Creek has been carried out since 1980 by Region staff. Monitoring reports are produced annually.

2.0 MONITORING PROGRAM

2.1 Groundwater

Groundwater was monitored at ten nests of piezometers in 1984. Three of these are background wells (BH 1A, BH 5, and BH 17). Piezometer nest BH 26 was installed late in 1983 and was monitored for the first time in 1984. The location of the new well is shown on Figure 1 along with all other monitoring stations.

The 1984 monitoring dates are listed below. The piezometers were monitored from one to three times in 1984. Each visit included measurement of water levels and collection of groundwater samples. Each well was flushed before collecting the sample.

Monitoring Station	Date, 1984
BH 1A; 5; 12; 14 & 17	October 15
BH 13; 24I, II; 25I, II and 25A	April 24 October 15
BH 24III; 25III	April 24 July 17 October 15
BH 26	January 31 April 24 October 15

The groundwater samples were analyzed for the following parameters:

General:

- Conductivity
- pH
- hardness

Major Ions:

- chloride
- sulphate
- bicarbonate
- magnesium
- potassium
- calcium
- sodium

Nutrients:

- nitrate
- ammonia
- total kjeldahl

Organics:

- COD
- DOC
- Phenol

Metals:

- iron

Note: selected well samples were analzyed for nickel, zinc, chromium and copper.

2.2 Leachate

Leachate is monitored in manholes located on the collector system. A total of seven manholes are now installed, however water levels and leachate quality were monitored at only two of them (MH 1 and 4) during 1984. The monitoring dates were as follows:

Monitoring Station	Date, 1984
MH 1	July 17 October 23
MH 4	April 24 July 17 October 23

The samples from the leachate collector system were analyzed for:

conductivity
pH
chloride

2.3 Surface Water

Buckhorn Creek was monitored at three stations on the following dates:

Buckhorn Creek (upstream, Townline Road and downstream)	May 16 November 14

The three stream samples were analyzed for the same parameters as above plus dissolved oxygen. The water quality data for all sampling points is included in Tables 3 to 40.

2.4 Methane

Methane gas monitors are located around the site. GM 1 through GM 4 were monitored for the presence of methane gas during the 1984 program on the following dates:

December 23 (1983)
January 31
February 2
August 17
December 27

3.0 MONITORING RESULTS (1984)

3.1 Water Levels

The 1984 water level data shows the following conditions:

- downward gradients (recharge conditions) are present at all well locations except BH 12 and 17
- BH 12, and 17 appear to be located in a transition zone between recharge and discharge conditions
- lack of correlation between water level fluctuations in the shallow wells compared to the deep wells confirm a low permeability in the till (see hydrographs for BH 13 and 17, Figures 2 and 3)

Water level hydrographs for three typical well nests are shown on Figures 2 and 3, (Appendix A). The water level response continues to be more variable in the recharge area (BH 13) than the discharge area (BH 17).

Water levels at MH 1 and 4 are shown on Figure 5. The water levels in the manholes reflect the water table within the nearest landfill cell.

3.2 Groundwater Quality

Key leachate indicators, such as conductivity, pH, chlorides, sulphates and COD are plotted on graphs (see Appendix C) for selected manholes and piezometers. The 1984 range of concentrations for some indicators for the background wells, leachate (at the manhole) and around the landfill perimeter is listed below. Averages are listed in parentheses.

1984 QUALITY FOR BACKGROUND WELLS

Well Group	Conductivity (umhos/cm)	pH	Chloride (mg/L)	DOC (mg/L)
Shallow wells (5.3 to 7.0 m): (BH 1A-III, BH 5-III and BH 17-III):	460-1300 (880)	6.5-7.3(6.9)	29- 36 (33)	1.4-3.0(2.2)
Intermediate wells (8.7 to 10.5 m): (BH 1A-II, BH 5-II and BH 17-II):	390-1900(1313)	6.6-6.7(6.7)	30-226(113)	1.3-3.2(2.2)
Deep wells (9.6 to 19.5 m): (BH 1A-I, BH 5-I and BH 17-I):	220-2750(1790)	6.4-6.7(6.6)	16-208(139)	1.4-1.8(1.6)

The range of strengths is similar to previous monitoring. Most parameters appear to increase slightly with depth.

1984 LEACHATE QUALITY

Leachate quality from manholes in the leachate collector system show the following range in concentrations.

Conductivity (umhos/cm)	pH	Chloride (mg/L)
1600-8000(4700)	6.3-7.2(6.8)	29-500(161)

The 1984 data shows decreasing trends compared to an increasing pattern in 1983. The wide fluctuations at both manhole monitors may reflect seasonal variation in infiltration patterns. Significant infiltration (or accumulation of surface runoff) could dilute the leachate to less than normal concentrations.

1984 QUALITY FOR LANDFILL PERIMETER WELLS

Piezometer nests located around the perimeter of the landfill (BH 13, 22, 24 and 25) had the following range in concentrations for key leachate indicators in 1984.

Well Group	Conductivity (umhos/cm)	pH	Chloride (mg/L)	DOC (mg/L)
shallow wells (3.7 to 5.8 m)	1000-2900(2125)	6.7-7.1(6.9)	6- 29 (20)	1.4-24(6.9)
intermediate wells (7.0 to 12.2 m)	1600-2900(2383)	6.8-7.1(7.0)	11-124 (62)	1.4-10.9(3.6)
deep wells (10.7 to 18.7 m)	2100-2650(2458)	6.7-7.0(6.9)	148-230(195)	0.5-10.9(3.0)

There is still no clear indication that leachate has impacted any wells around the perimeter of the landfill. DOC is a new parameter that was added to the 1984 analyses. It appears to be elevated above background in the shallow piezometer at the BH 24 nest (24 mg/L compared to less than 6 mg/L in other shallow monitors). More data are needed to establish the degree of natural fluctuation for DOC before conclusions of leachate impacts can be drawn.

3.3 Surface Water

Buckhorn Creek was sampled on two occasions in 1984 (May 16 and November 14). The upstream water quality results (Table 38) shows lower conductivity and chloride than the results for samples taken at Townline Road (Table 39) and downstream (Table 40). The chloride levels increase by a factor of up to two, from upstream levels of about 20 mg/L. The increased chloride loading in the stream reflects a pattern that also occurred in the 1982 and 1983 monitoring.

Although chloride is usually a good indicator of landfill leachate, other sources could contribute to this impact. These include road salting activities (both winter and summer) and the storm water ponds. We understand the ponds are emptied into the creek 5 or 6 times per year. The initial pond (No. 1), which is located about 20 m from the creek, apparently has shown a gradual increase in chemistry since the beginning. (Note that the storm water quality is not reported).

The trend of increased chlorides downstream of the landfill warrants more comprehensive monitoring of the stream. A four-seasons study of the flow characteristics is needed. We understand that flow is intermittant during the summer months. This needs to be documented. More complete chemistry is required to characterize natural variation and establish other impact sources. Contaminant sources such as agricultural activities (fertilizers, pesticides) and wetlands often contribute chemicals to surface waters that are similar to those found in landfill leachate.

4.0 METHANE GAS

There were four gas probes monitored in 1984. A fifth gas probe (GM 5) was installed in December, 1983, but was not included in the monitoring.

The following table is a summary of the 1984 monitoring results.

Methane (% by volume)

Probe	Dec 23(1983)	Jan 31	Feb 2	Apr 27	Aug 17	Dec 27
GM 1	0	0.25	0.25	0.25	0.9	0
GM 2	0	0	0.25	0.25	0	0
GM 3	0.25	0	0.25	0.25	0	0
GM 4	-	0.25	0.25	0.25	0	0

All of the above measurements are well below the explosive limit for methane (5-15% by volume). These results confirm conclusions made in our 1983 report. There should be no hazard from methane at this site as long as building is not allowed on the landfill or immediately adjacent to it.

5.0 CONCLUSIONS

The following are conclusions based on our review of the 1984 monitoring data and data from previous years.

1) Leachate quality remains weak compared to older sites. Some decreases in chloride and conductivity levels were noted. These decreases may be due to dilution from seasonal variations in infiltration.

2) Examination of the water level recovery in completed cells shows that it is slow. Hydrographs of water levels in manholes show a period of readjustment after each major cell is opened. The landfill water table at the end of 1984 had not recovered to the regional water table. There should be no need to remove leachate from the site until the water levels in the landfill recover to the surrounding water table.

3) Significant groundwater impacts would not be expected until water levels in the landfill mound above the regional water table.

4) Downstream surface water samples in Buckhorn Creek show slight increases in conductivity and chloride concentrations compared to upstream samples. This trend was also seen in 1982 and 1983. The source of the increased chlorides may be landfill-related (road salting or storm water runoff), but more comprehensive analyses are needed to confirm this.

5) There does not appear to be a concern of methane migration through the weathered tills surrounding the site; however, it is possible that methane could accumulate in manholes at the landfill perimeter.

6.0 RECOMMENDATIONS

1. WATER SAMPLING

The monitoring program to date has been adequate to identify natural conditions at the site. In the future, we recommend emphasis be placed on stream monitoring because of apparent impacts on Buckhorn Creek. The following sampling program should be carried out. A few modifications have been made to the frequency and number of sampling points and to the parameters for analysis.

i) Groundwater:	Wells	- one background well nest (BH 12 or 14)
		- BH 13III, BH 24III, BH 25III, BH 26III
	Frequency	- could be reduced to twice yearly
	Parameters	- same as 1983 monitoring
ii) Stream: (Buckhorn Creek)	Stations	- existing 3 stations
		- a walking survey of Buckhorn Creek should be done to identify all significant surface impacts to the main stream (e.g., all road ditches, agricultural drains and minor tributaries).
	Frequency	- a four-seasons study should be conducted sometime within the next 2 years
		- the study should examine water quality every one to two months for a 12-month period

	Parameters	- the four-seasons study should include the following parameters in order to identify all sources of impact
	general:	pH, conductance, hardness, alkalinity
	major ions:	chloride, calcium, sodium, sulphate
	nutrients:	nitrogen group (Kjeldahl N, ammonia, nitrate)
	organics:	BOD_5, COD, DOC, phenol
	metals:	iron
iii) Leachate:	Manholes	- MH 1, MH 4, MH 14 (opposite Cell 3)
	Frequency	- twice yearly
	Parameters	- same as groundwater parameters including BOD_5
iv) Storm Water:	Frequency	- whenever ponds are discharged into Buckhorn Creek
	Parameters	- same as listed for creek samples

2. HYDROGEOLOGIC CONDITIONS

The future impacts of this landfill will depend on the pattern of leachate movement away from the site. Conditions affecting this should be monitored more closely in the future.

i) Groundwater: Water Levels - all shallow wells twice yearly

ii) Stream: Flow
- a four-season study of the flow characteristics should be conducted sometime within the next 2 years (no-background data on flow patterns exists)
- if it is not possible to measure the flows by means of a weir, they should be estimated from velocity and cross-section measurements; the following categories of flow are suitable:
  - DRY - no flow
  - A - less than 1 L/s
  - B - 1 to 5 L/s
  - C - 5 to 25 L/s
  - D - over 25 L/s
- the flow should be monitored whenever water samples are collected (i.e., every one to two months for the four-season study

iii) Landfill Water Table: Manhole Levels - quarterly to establish seasonal pattern of recovery and effects of cell expansions

iv) Storm water: Pond Discharge - record date of discharge and approximate volume of discharge for each storm water pond

3. OPERATIONS

The following details of site operation should be recorded.

i) staging and site development

ii) movement or recirculation of leachate within landfill cells

iii) off-site haulage of leachate (and reasons)

4. There is no need to continue monitoring the methane gas probes; however; methane levels in the manholes should be checked prior to entry by any personnel. If methane is detected, appropriate safeguards should be taken to protect the field personnel.

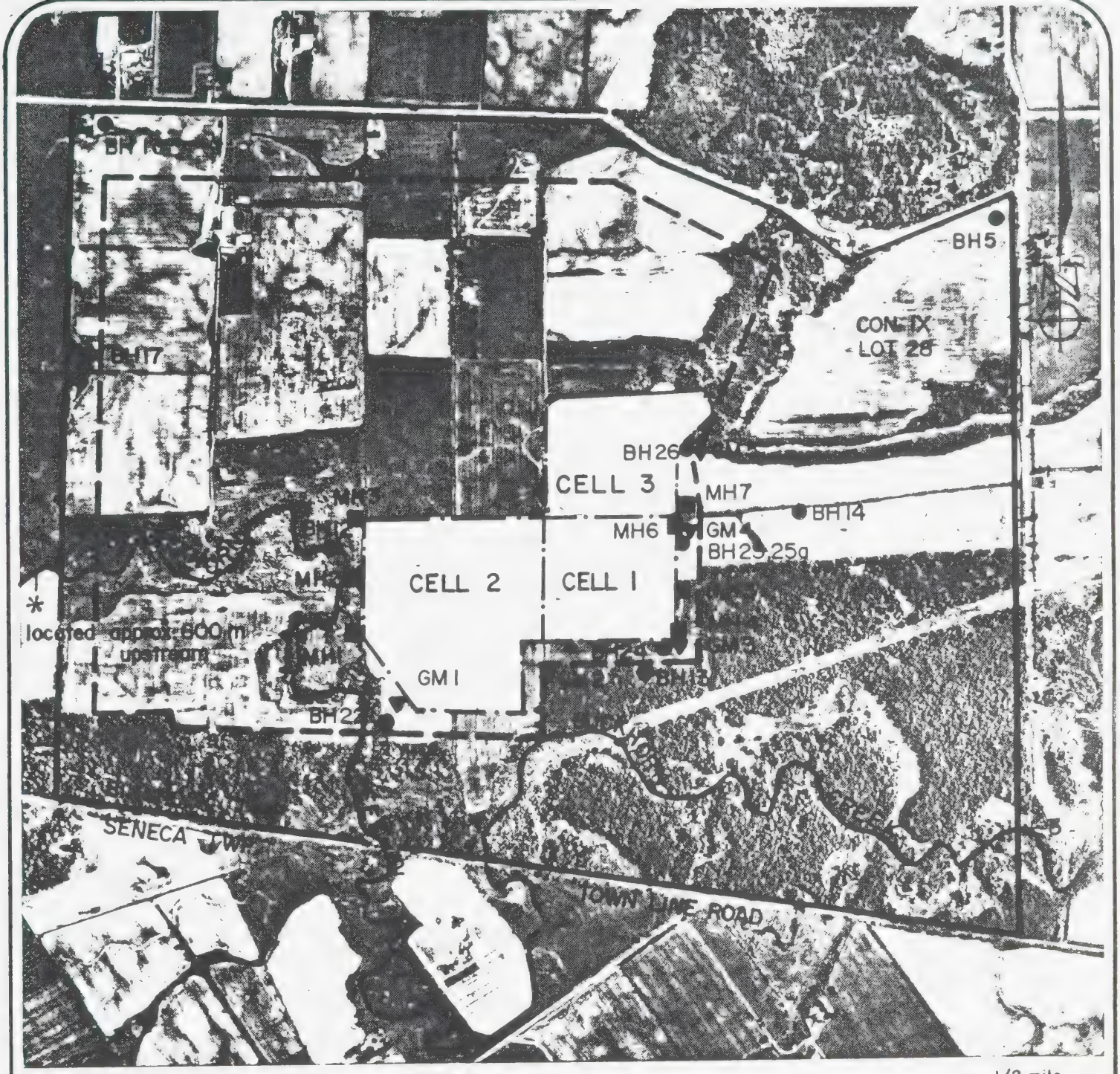
Respectfully submitted,
MORRISON BEATTY LIMITED

Nancy J. Rennie, B.E.S.
Environmental Geomorphologist

Brian W. Beatty, P.Eng.

APPENDIX A

FIGURES



1/2 0 1/2 mile

SCALE 1:10,000

500 0 500 metres

LEGEND

- Property Boundary
- Ultimate Landfill Limits
- BH 12 ● Groundwater Monitor (borehole)
- GM 4 ▼ Gas Monitor
- MH 3 ■ Man Hole
- ✳ Surface water sample point

REGION OF HAMILTON - WENTWORTH

GLANBROOK LANDFILL SITE

ANNUAL MONITORING REPORT

AIR PHOTO LOCATION

PROJECT NO. 386-841	MAR. 1985

morrison beatty limited
consulting engineers and hydrogeologists

1

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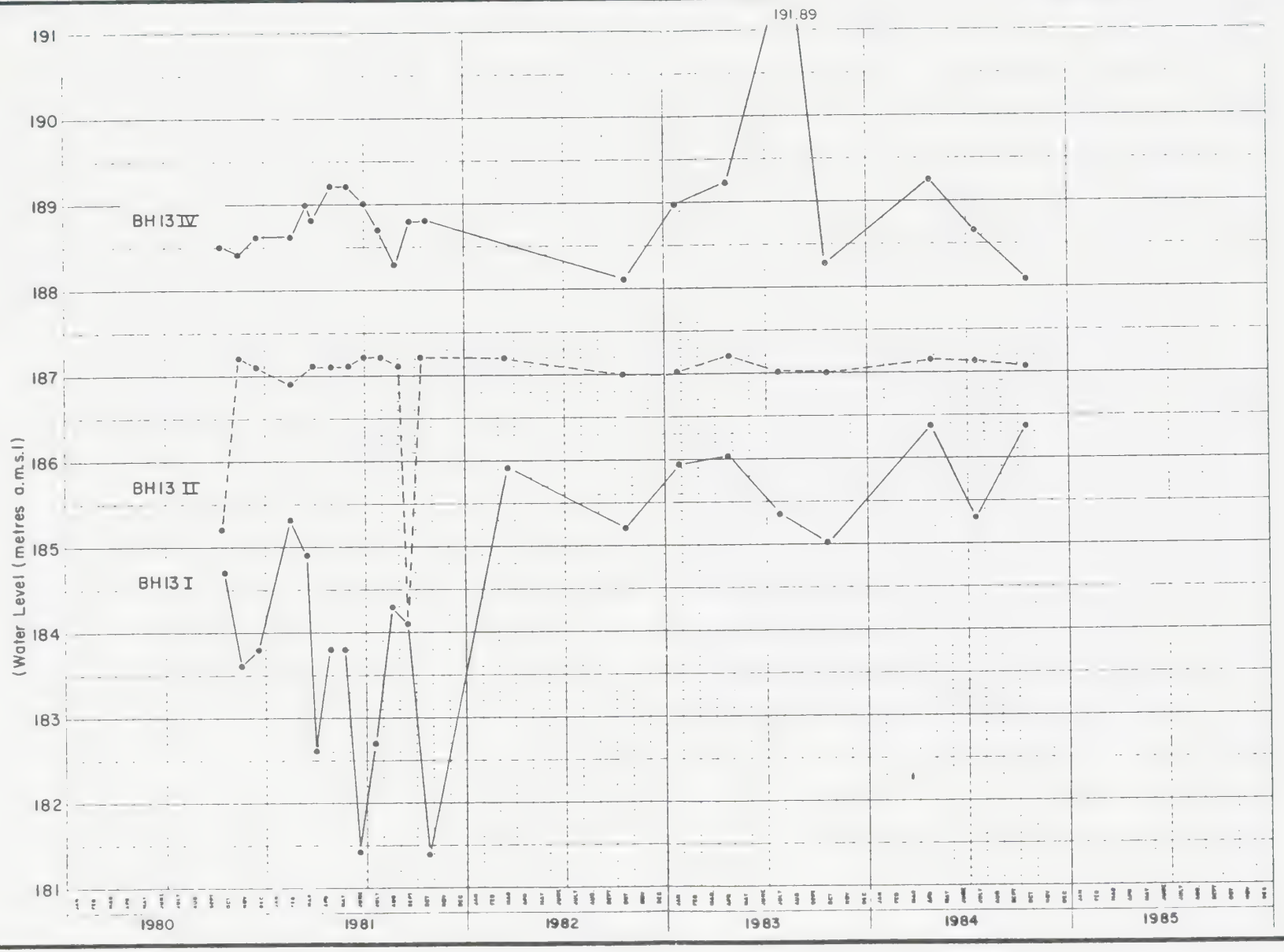
REGION OF HAMILTON - WENTWORTH
GLANBROOK LANDFILL SITE

Hydrograph for well nest BH13



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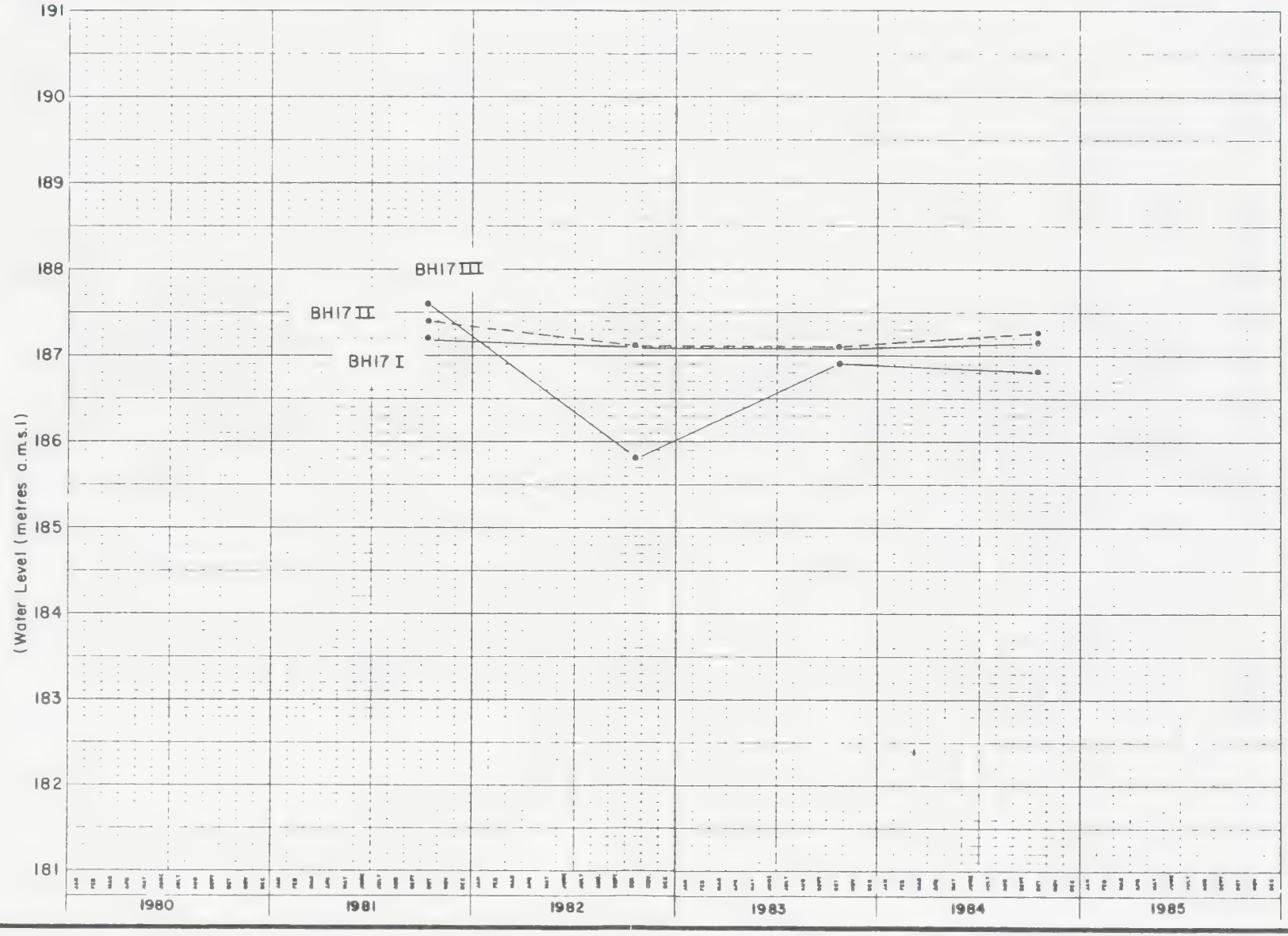
Hydrograph for well nest BH17

3



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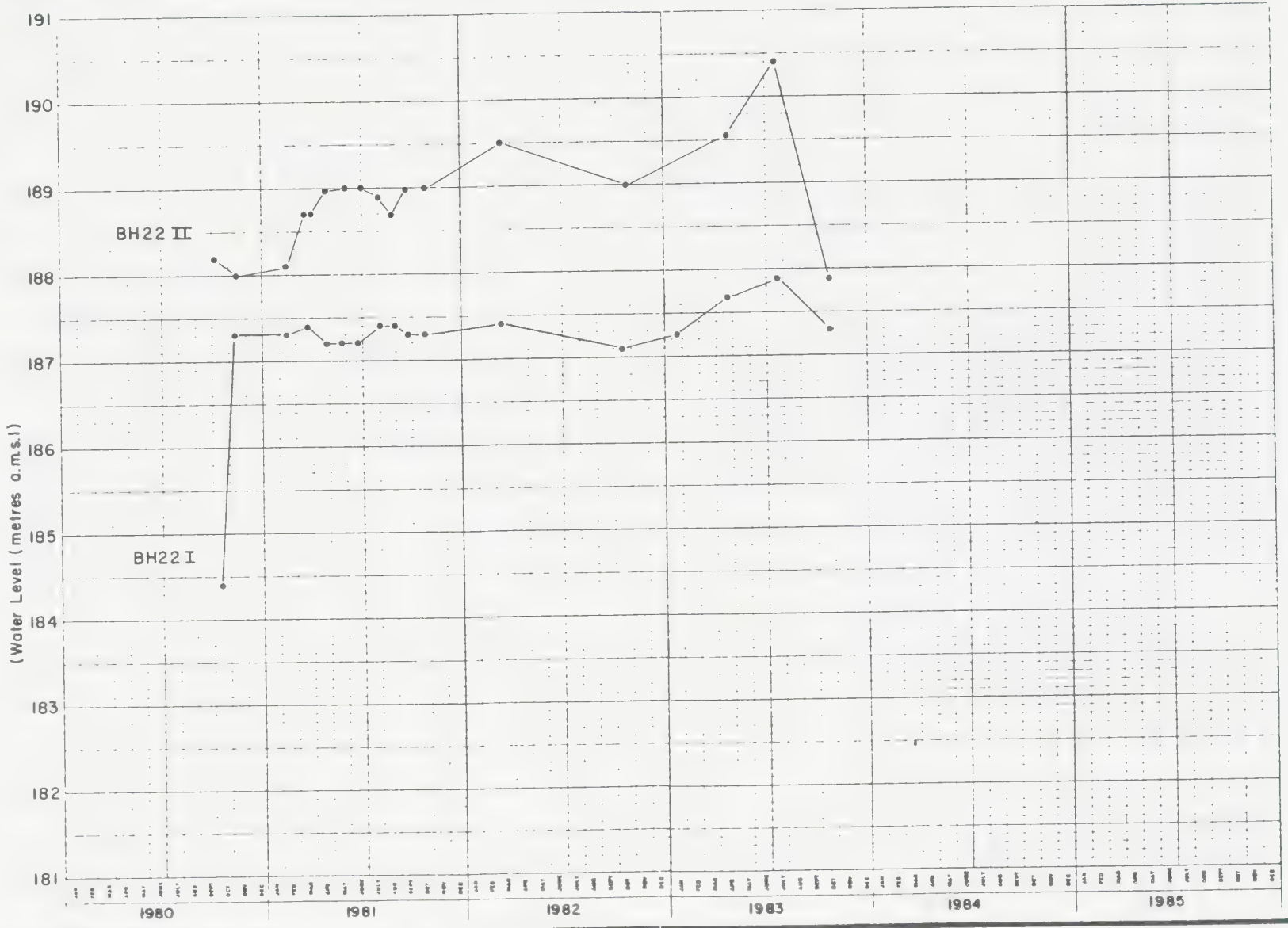
Hydrograph for well nest BH22

4



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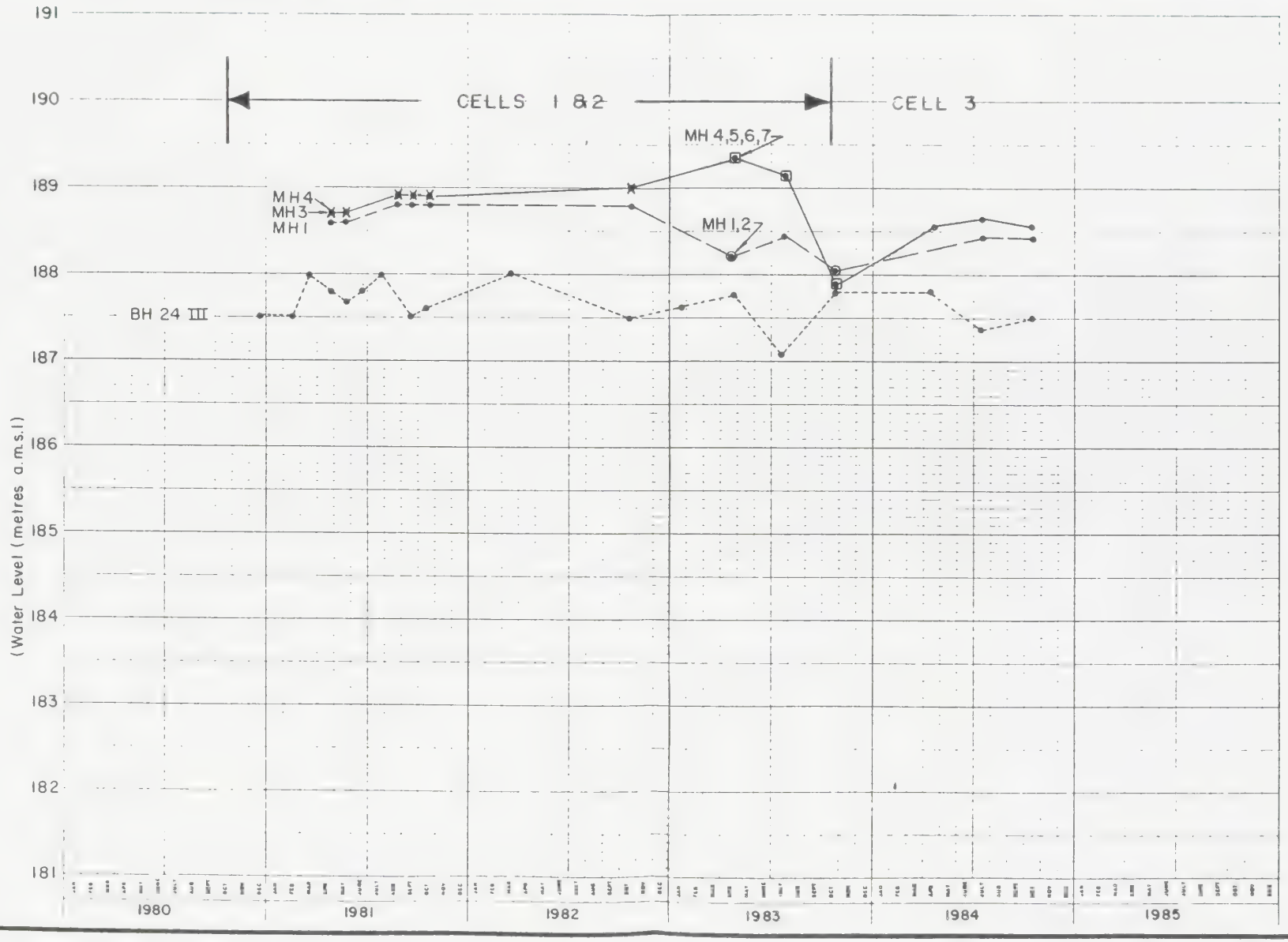
REGION OF HAMILTON - WENTWORTH
GLANBROOK LANDFILL SITE

Hydrograph for well nest BH 24 & MH'S

5



APPENDIX B

TABLES

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE

TABLE 1A: WATER LEVEL DATA

WELL NUMBER	Depth metres	Ground Level mamsl.		DATE D/M/YR																	
				27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	28/04	20/05	25/06	29/07	26/08	29/09	15/10 1981	25/03 1982	22/10	28/01 1983	26/04	28/07
1a - I	19.5	191.19														187.6		187.0			
II	10.5	191.9														188.0		187.6			
III	6.1	191.9														190.4		189.9			
5 - I	11.7	189.88														186.7		184.7			
II	8.8	189.88														189.6		185.9			
III	7.0	189.88														188.9		188.3			
12 - I	14.3	191.47														187.1		187.0			
II	10.8	191.50														187.3		186.7			
III	6.1	191.50														187.8		185.8			
13 - I	18.7	189.72		184.7	183.6	183.8	185.3	184.9	182.6	183.8	183.8	181.4	182.7	184.3	184.1	181.4	185.9	185.2	185.94	186.01	185.34
II	12.2	189.72		185.2	187.2	187.1	186.9	—	187.1	187.1	187.1	187.2	187.2	187.1	184.1	187.2	187.2	187.0	187.00	187.22	187.01
III	10.1	189.72																187.0	187.03	187.23	187.01
IV	5.2	189.88		188.5	188.4	188.6	188.6	189.0	188.8	189.2	189.2	189.0	188.7	188.3	188.8	188.8	—	188.1	188.97	189.25	191.89
14 - I	19.7	194.11		185.3	185.8	185.6	185.6	186.0	185.9	185.8	185.8	186.2	185.8	185.8	185.7	185.9	185.9	185.5			
II	15.2	194.11		187.5	187.8	187.8	187.7	188.0	187.9	187.8	187.8	188.0	188.0	188.6	188.0	187.8	188.2	188.0			
III	9.1	194.30		190.5	190.5	190.7	189.6	191.0	190.9	191.2	191.2	191.3	190.9	191.1	191.3	191.4	191.6	190.5			
17 - I	9.6	188.60														187.2		187.1			
II	8.7	188.60														187.3		187.1			
III	5.3	188.60														187.6		185.8			
22 - I	10.7	190.75		185.4	187.3	—	187.3	187.4	187.2	187.2	187.2	187.4	187.4	187.2	187.3	187.3	187.4	187.1	—	189.58	190.45
II	5.8	190.75		188.2	188.0	—	188.1	188.7	188.7	189.0	189.0	189.0	188.9	188.7	189.0	189.0	189.5	189.0	187.26	187.69	188.99
24 - I	12.2	189.36		185.0	186.9	186.9	186.8	187.0	186.9	186.9	186.8	186.8	186.9	186.9	186.9	186.8	187.0	186.7	186.93	186.98	186.73
II	7.0	189.36		187.6	187.7	187.5	187.5	188.0	187.7	187.8	187.7	187.8	188.0	187.4	187.7	187.6	188.0	187.5	187.63	187.73	187.09
III	3.7	189.36		187.6	187.7	187.5	187.5	188.0	187.7	187.8	187.7	187.8	188.0	187.5	187.7	187.6	188.0	187.5	187.63	187.75	187.08
25 - I	15.2	193.17		185.1	187.0	186.9	186.8	187.0	186.8	186.9	186.9	187.0	186.9	186.9	187.0	186.9	187.1	186.8	186.82	187.00	186.81
II	7.3	193.17		188.5	188.6	188.7	188.7	189.2	189.1	189.3	189.4	189.4	189.4	189.4	189.5	189.5	189.9	189.5	190.01	190.30	189.75
III	4.3	193.17		189.7	189.6	190.0	189.7	-	191.3	192.2	192.3	191.7	191.7	190.7	191.6	191.8	192.2	190.5	192.03	192.22	191.07
25a - I	7.3	193.11		188.4	188.6	188.8	188.7	188.9	189.2	189.3	189.5	189.5	189.5	189.4	188.0	—	190.0	189.5	189.88	190.30	189.82

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE

TABLE 1B: WATER LEVEL DATA

Well No.	Depth metres	* Ground Level mamsl		DATE D/M/YR 31/10 1983	24/04 1984	17/07	15/10														
1a - I	19.5	[illegible]		187.02			187.29														
II	10.5	[illegible]		187.40			187.71														
III	6.1	[illegible]		189.73			189.84														
5 - I	11.7	189.88		186.71			185.69														
II	8.8	189.88		186.50			188.65														
III	7.0	189.88		188.44			188.17														
12 - I	14.3	191.47		187.06			187.03														
II	10.8	191.50		186.73			186.75														
III	6.1	191.50		185.74			185.77														
13 - I	18.7	[illegible]		185.04	186.38	185.30	186.38														
II	12.2	[illegible]		187.00	187.15	187.12	187.07														
III	10.1	189.72		187.01	187.16	187.11	187.07														
IV	5.2	189.88		188.29	189.26	188.66	188.09														
14 - I	19.7	194.12		185.65			185.70														
II	15.2	194.12		188.11			188.14														
III	9.1	194.30		191.03			191.15														
17 - I	9.6	188.60		187.16			187.17														
II	8.1	188.60		187.15			187.29														
III	5.3	188.60		186.92			186.83														
22 - I	10.7	190.75		187.33			—														
II	5.8	190.75		188.90			—														
24 - I	12.2	189.36		186.78	186.93	186.83	186.87														
II	7.0	189.36		187.79	187.83	187.38	187.49														
III	3.7	189.36		187.79	187.82	187.38	187.50														
25 - I	15.2	193.17		186.89	186.97	186.91	186.92														
II	7.3	193.17		188.30	189.93	189.64	189.37														
III	4.3	193.17		191.37	191.84	190.46	189.81														
25a - I	7.3	193.11		188.27	189.75	189.58	189.32														

* 1983

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE

TABLE 1c: WATER LEVEL DATA

Well Number	Depth metres	Ground Level mamsl.		DATE D/M/YR 31/01 1984	24/04	17/07	15/10													
26 - I				186.6	187.24	186.97	186.71													
II				186.47	187.38	187.08	186.71													
III				dry	188.70	188.40	188.40													

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE

TABLE 2A: WATER LEVEL DATA

Manhole No.	Depth metres	Ground Level mams.		DATE D/M/YR																	
				28/04 1981	20/05	25/06	29/07	26/08	29/09 1981	22/10 1982	26/04 1983	28/07	31/10	24/04 1984	17/07	23/10					
MH-1		193.48		188.6	188.6	-	188.8	188.8	188.8	188.8	188.2	188.44	188.15	-	188.45	188.43					
MH-2											188.12		188.16								
MH-3		192.07		188.7	188.7	-	188.8	188.8	188.9	189.0											
MH-4		191.17		188.7	188.7	-	188.9	188.9	188.9	189.0	189.35	189.17	187.86	188.56	188.64	188.54					
MH-5		192.01									189.3	189.11	187.81								
MH-6		192.78									189.32	189.16	187.85								
MH-7		193.48									189.25	189.08	187.81								

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 3 : MANHOLE 1

Constituent mg/L	DATE D/M/YR																			
	29/04 1981	22/05	25/06	29/07	27/08	29/09 1981	25/03 1982	19/10	28/01 1993	26/04	28/07	31/10	17/01 1984	23/10						
Conductance	2600	2250	1900	—	—	4000	230	2900	1800	4900	6000	800	6500	5000						
pH	6.8	7.2	7.0	—	—	7.1	7.5	7.6	6.9	7.0	6.9	6.1	6.5	7.2						
Chloride	99	45	45	—	—	61	8	0.7	37.5	310	285	900	500	32						
Hardness								2270												
Sulphate								1400												
Kjeldahl N								4.32												
Nitrate								0												
Phenol								0												
BOD																				
COD								29												
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium								0.04												
Copper								0.02												
Iron								3.4												
Lead																				
Manganese																				
Nickel								0.04												
Zinc								0.52												

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 4 : MANHOLE 2

Constituent mg/L	DATE D/M/YR																			
	19/10 1982	31/10 1983																		
Conductance	2900	6000																		
pH	7.5	6.95																		
Chloride	0.7	225																		
Hardness	2093																			
Sulphate	1540																			
Kjeldahl N	4.32																			
Nitrate	0.01																			
Phenol	0																			
BOD																				
COD	44																			
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium	N.D.																			
Copper	0.01																			
Iron	1.79																			
Lead																				
Manganese																				
Nickel	0.02																			
Zinc	0.03																			

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 5 : MANHOLE 3

Constituent mg/L	DATE D/M/YR																					
	29/04 1981	22/05	25/06	29/07	27/08	29/09 1981	25/03 1982	19/10	31/10 1983													
Conductance	2050	2500	2500	2600	2700	3000	1200	3300	2000													
pH	7.0	7.1	7.0	7.4	7.8	7.6	8.0	7.5	6.8													
Chloride	53	38	91	67	53	53	23	8.5	43.0													
Hardness																						
Sulphate								2335														
Kjeldahl N								1720														
Nitrate								8.32														
Phenol								0.01														
BOD								0														
COD																						
TOC								22														
Sodium																						
Potassium																						
Calcium																						
Magnesium																						
Phosphorus P																						
Cadmium																						
Chromium																						
Copper								N.D.														
Iron								N.D.														
Lead								0.65														
Manganese																						
Nickel																						
Zinc								0.03														
								0.02														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
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WATER CHEMISTRY

TABLE 6 : MANHOLE 4

Constituent mg/L	DATE D/M/YR																		
	29/04 1981	22/05	25/06	29/07	27/08	29/09 1981	25/03 1982	19/10	31/10 1982	26/04	28/07	31/10 83	24/04 1984	17/07	23/10				
Conductance	1850	2100	2900	2500	2600	3000	2700	3550	2100	3350	4000	3900	8000	2400	1600				
pH	7.2	7.1	7.0	7.2	7.5	7.3	7.3	7.4	6.8	6.9	6.7	5.5	6.9	6.3	6.8				
Chloride	40	53	91	61	68	45	83	0.5	60.0	110.0	100	275	100	145	29				
Hardness								2580											
Sulphate								1650											
Kjeldahl N								10.12											
Nitrate								0											
Phenol								0											
BOD																			
COD								59											
TOC																			
Sodium																			
Potassium																			
Calcium																			
Magnesium																			
Phosphorus P																			
Cadmium																			
Chromium								N.D.											
Copper								0											
Iron								1.10											
Lead																			
Manganese																			
Nickel								0.02											
Zinc								0.01											

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 6B: MANHOLE 5

Constituent mg/L	DATE D/M/YR 26/04 1983																			
Conductance	2700																			
pH	6.9																			
Chloride	57.0																			
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 6c: MANHOLE 6

Constituent mg/L	DATE D/M/YR																			
	26/04 1983																			
Conductance	2550																			
pH	7.0																			
Chloride	42.0																			
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 6D: MANHOLE 7

Constituent mg/L	DATE D/M/YR 26/04 1983																			
Conductance	2100																			
pH	7.0																			
Chloride	41.0																			
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
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WATER CHEMISTRY

TABLE 7 : BH 1A-I

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984																
Conductance	3100 2900	2900	3050	2000	2750																
pH	7.8 7.8	7.5	7.2	6.7	6.65																
Chloride	198 205	205	176	141	194																
Hardness	1680 1600	----	1800	1760	2100																
Sulphate	1550 1530	---	1500	1350	1500																
Kjeldahl N	0.55 0.69	----	0.56	0.0	1.2																
Nitrate	<0.05 <0.05	---	0.08	<.01	0.4																
Phenol	0.097 0.025	---	N.D.	.003																	
BOD	0.7 0.7	---		<1																	
COD	----	---	22	<5	18																
TOC	1.0 1.0			---																	
Sodium	132 156	---		----	56																
Potassium	6.7 6.8	---	----	---	2.8																
Calcium	370 399	---	----	---	395																
Magnesium	195 200	---	---	----	---																
Phosphorus P	----	---	---	---																	
Cadmium	N.D. <0.01	---	----	---	---																
Chromium	N.D. <0.02	---	0.09	<.10	---																
Copper	N.D. <0.05	---	0.02	<.05																	
Iron	0.09 0.3	---	0.09	<.05	<.05																
Lead	0.1 <0.1	---	---	---	---																
Manganese	<0.1 <0.1	---	---	---	<.1																
Nickel	N.D. 0.05	---	0.05	<.02																	
Zinc	0.1 <0.01	---	0.10	0.05																	
Ammonia					0.78																
DOC					1.4																
Alkalinity					230																

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 8 : BH 1A-II

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984															
Conductance	2900 2900	2750	2600	1800	1900															
pH	7.9 7.9	7.5	7.5	7.0	6.65															
Chloride	260 262	235	200	148	226															
Hardness	1530 1690		1445	1440	1700															
Sulphate	1270 1260		1150	1000	1091															
Kjeldahl N	0.94 0.59		0.32	0.44	1.90															
Nitrate	<0.05 <0.05		0.67	0.1	N.D.															
Phenol	0.013 0.027		N.D.	.0102																
BOD	0.7 4.7			<1																
COD			60	<5	75															
TOC	1.0 0.5																			
Sodium	129 142				132															
Potassium	3.8 3.8				10															
Calcium	287 301				233															
Magnesium	203 206																			
Phosphorus P																				
Cadmium	N.D. <0.01																			
Chromium	N.D. <0.02		0.08	<.10																
Copper	N.D. <0.05		0.02	<.05																
Iron	0.07 1.34		0.79	0.11	<.05															
Lead	0.1 0.1																			
Manganese	0.1 <0.1				<.1															
Nickel	N.D. <0.05		0.02	<.02																
Zinc	N.D. 0.01		<0.01	0.02																
Ammonia					.88															
DOC					1.3															
Alkalinity					230															

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 9 : BH 1A-III

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	8/10 1982	31/10 1983	15/10 82																
Conductance	2600 2500	2400	↓	1700	↑																
pH	7.6 7.6	7.5		6.8																	
Chloride	110 112	99		100																	
Hardness	1170 1270			1350																	
Sulphate	920 1040			900																	
Kjeldahl N	0.72 4.0			0.2+																	
Nitrate	<0.05 0.32			<.01																	
Phenol	0.027			.013+																	
BOD	2.6		0	6	0																
COD			∧	15	∧																
TOC	3.0 1.9		<		<																
Sodium	153 162																				
Potassium	4.7 4.3																				
Calcium	231 252																				
Magnesium	168 175																				
Phosphorus P																					
Cadmium	N.D. <0.01																				
Chromium	N.D. <0.02			<.10																	
Copper	N.D. <0.05			<.05																	
Iron	0.23 3.12			0.22																	
Lead	0.1 0.1																				
Manganese	0.8 0.75																				
Nickel	N.D. <0.05			<.02																	
Zinc	N.D. <0.01		∨	0.01	∨																

REGIONAL MUNICIPALITY HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 10 : BH 5-1

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984																
Conductance	2600 2080	2450	245	170	220																
pH	7.5 7.7	7.5	7.7	5.7	6.4																
Chloride	210 216	182	8	4.9	16																
Hardness	1200 1350		105	100	270																
Sulphate	1160 1210		13	27	13																
Kjeldahl N	0.36 0.40		0.56	0.12	0.90																
Nitrate	<0.05 –		1.10	0.8	0.05																
Phenol	0.035 0.028		N.D.	.012																	
BOD	0.5 0.9																				
COD			30	21	29																
TOC	1.5 1.5																				
Sodium	112 130				1.0																
Potassium	2.5 3.5																				
Calcium	288 305				90																
Magnesium	151 150				11																
Phosphorus P																					
Cadmium	N.D. <0.01																				
Chromium	N.D. <0.02		0.04	<.10																	
Copper	N.D <0.05		<0.01	<.05																	
Iron	0.12 0.56		0.02	0.11	1.20																
Lead	0.1 <0.1																				
Manganese	1.1 1.45				<.1																
Nickel	N.D. <0.05		<0.01	<.02																	
Zinc	N.D. 0.03		<0.01	<.01																	
Ammonia					0.70																
DOC					1.8																
Alkalinity					105																

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 11 : BH 5-II

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984																
Conductance	1750 1690	900	600	330	390																
pH	7.9 7.9	7.0	8.0	7.1	6.6																
Chloride	94 130	53	28	12	30																
Hardness	750 750		316	240	400																
Sulphate	530 600		110	40	30																
Kjeldahl N	0.48 0.42		0.56	0.12	1.20																
Nitrate	<0.05 <0.05		1.06	1.3	0.25																
Phenol	0.015 0.024		N.D.	.0173	.0102																
BOD	- 36			11																	
COD			73	51	25																
TOC	4.5 1.0																				
Sodium	118 116				2.0																
Potassium	1.5 1.0				0.2																
Calcium	120 131				130																
Magnesium	114 116				18																
Phosphorus P																					
Cadmium	N.D. <0.01																				
Chromium	N.D. <0.02		0.03	<.10																	
Copper	N.D. <0.05		0.08	<.05																	
Iron	0.12 1.55		0.30	0.05	<.05																
Lead	0.1 <0.1																				
Manganese	0.2 1.10				<.1																
Nickel	N.D. <0.05		0.01	<.02																	
Zinc	N.D. <0.01		0.01	0.02																	
Ammonia					0.62																
DOC					3.2																
Alkalinity					220																

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 13 : BH 12-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984														
Conductance	3200 3150	2900	1250	1200	1350														
pH	7.1 7.5	8.0	7.4	7.2	6.6														
Chloride	240 243	227	6	24	36														
Hardness	1720 1740		833	790	1010														
Sulphate	1490 1640		530	500	511														
Kjeldahl N	0.38 0.42		0.58	0.12	1.1														
Nitrate	<0.05 <0.05		N.D.	0.2	0.25														
Phenol	0.007 0.021		N.D.	—															
BOD	7.7 7.3			38															
COD			22	<5	34														
TOC	2.0 <0.5																		
Sodium	139 156				43.4														
Potassium	6.8 6.7				0.2														
Calcium	410 424				223														
Magnesium	160 166				110														
Phosphorus P																			
Cadmium																			
Chromium			0.01	<.10															
Copper			0.09	<.05															
Iron	0.07 0.12		0.37	<.05	<.05														
Lead																			
Manganese					0.19														
Nickel			0.01	<.02															
Zinc			0.01	<.01															
Ammonia					.64														
DOC					1.9														
Alkalinity					320														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
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WATER CHEMISTRY

TABLE 14 : BH 12-II

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984															
Conductance	2900 2650	1750	1250	900	1500															
pH	7.3 7.8	7.5	7.5	6.8	6.7															
Chloride	69 67	38	5	11	54															
Hardness	1820 1590		810	570	2168															
Sulphate	1560 1450		50	270	648															
Kjeldahl N	0.46 0.33		0.32	0.0	1.7															
Nitrate	<0.05 <0.05		0.12	0.3	0.2															
Phenol	0.011 0.026		N.D.	.0714																
BOD	0.9 0.5			2																
COD			22	<5	25															
TOC	3.5 1.0																			
Sodium	77 88				23.6															
Potassium	4.2 4.2				2.7															
Calcium	274 200				669															
Magnesium	278 249				120															
Phosphorus P																				
Cadmium																				
Chromium			0.03	<.10																
Copper			0.05	<.05																
Iron	0.10 0.24		0.14	<.05	<.05															
Lead																				
Manganese					0.16															
Nickel			<0.01	<.02																
Zinc			0.01	<.01																
Ammonia					0.70															
DOC					1.8															
Alkalinity					208															

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TABLE 15 : BH 12-III

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984															
Conductance		5900	↑	↑	↑															
pH	8.3	7.5																		
Chloride		121																		
Hardness																				
Sulphate	4100																			
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD				↓	↑															
COD																				
TOC																				
Sodium	294																			
Potassium	10.9																			
Calcium	133																			
Magnesium	995																			
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron	0.57																			
Lead																				
Manganese																				
Nickel																				
Zinc			↓	↓	↓															

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 16A: BH 13-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	1500 1600	–	2500	2500	2500	1800	2800	3000	2750	–	–	2600	2750	2900	2400	2700	–	2900	2750	1700
pH	8.0 7.1	8.0	7.7	7.8	7.9	8.6	8.3	8.3	8.2	–	–	8.3	7.9	7.5	7.3	6.7	–	7.1	6.7	7.2
Chloride	– 130	180	182	122	193	240	227	205	167	–	–	235	212	225	227	195	–	173	118	102
Hardness	– 450													700						229
Sulphate	560 540													1225						835
Kjeldahl N														3.4						1.52
Nitrate														0.02						0.13
Phenol														0.040						0
BOD														0.3						
COD																				22
TOC	6.0 2.5																			
Sodium	145 166													185						
Potassium	9.6 11.0													2.9						
Calcium	49 63													110						
Magnesium	79 81													190						
Phosphorus P														0.3						
Cadmium	N.D. –													N.D.						
Chromium	N.D. –													N.D.						0.12
Copper	N.D. –													N.D.						0.06
Iron	<0.1 –													0.5						0.23
Lead	0.2 –													N.D.						
Manganese	1.3 –													0.1						
Nickel	N.D. –													N.D.						0.01
Zinc	N.D. –													N.D.						0.04

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 16B: BH 13-I

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	2700	2800		2600	2100	2700														
pH	7.0	6.7		7.1	7.0	6.7														
Chloride	175	196		153	196	208														
Hardness	1657	1500		1550	1640	1680														
Sulphate	1525	1450		1450	1560	716														
Kjeldahl N	1.02	2.0		2.32	3.52	2.6														
Nitrate	1.12	0.20		0.3	1.20	ND														
Phenol	.030	.038		—	.003															
BOD		1.2		32	6															
COD	51	13		<5	15	16														
TOC			W																	
Sodium			J			190														
Potassium			O			16.8														
Calcium			E			310														
Magnesium			¢			220														
Phosphorus P			⊕																	
Cadmium																				
Chromium	0.13	<.10	O	<.10																
Copper	0.03	0.03	2	<.05	0.05															
Iron	0.42	0.57		<.05	0.5	<.05														
Lead																				
Manganese						<.1														
Nickel	<.05	<.05		<.02																
Zinc	0.06	<.01		0.03	0.10															
Ammonia						2.1														
DOC						0.5														
Alkalinity						50														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 17A: BH 13-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	3050 2600	2200	2500	2400	2100	1800	1900	1900	2000	1700	1600	1650	1750	2100	1700	1700	1550	1720	1700	1250
pH	7.7 7.5	7.7	7.7	7.7	7.8	7.9	8.1	7.9	7.9	7.8	7.7	7.6	7.6	7.4	8.0	6.7	7.1	7.0	6.9	7.6
Chloride	260 218	165	182	182	171	200	144	144	114	180	152	174	129	215	159	121	106	97	115	78
Hardness	1570 1360													680						579
Sulphate	1670 1290													1200						350
Kjeldahl N	0.46 0.34													0.6						1.6
Nitrate	<0.05 <0.05													0						0.13
Phenol	0.0059 0.0024													0.047						0
BOD	0.7 0.5													0						
COD																				60
TOC	1.0 0.5																			
Sodium	159 154													160						
Potassium	4.6 2.9													3.5						
Calcium	406 293													320						
Magnesium	159 154													130						
Phosphorus P														0.06						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.01													N.D.						0.06
Copper	N.D. <0.05													N.D.						0.08
Iron	<0.1 <0.05													1.0						0.36
Lead	<0.1 <0.1													N.D.						
Manganese	0.1 0.1													0.1						
Nickel	N.D. <0.05													N.D.						<0.01
Zinc	N.D. <0.01													N.D.						0.07

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 17B BH 13-II

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	1600	1600	1980	1900	1600	1600														
pH	7.2	7.5	7.3	7.4	7.1	6.9														
Chloride	120	110	152	137	116	124														
Hardness	811	744	810	1120	860	1000														
Sulphate	850	725	925	920	781	921														
Kjeldahl N	0.38	0.88	<.01	0.56	3.2	0.90														
Nitrate	0.08	0.02	0.02	0.1	ND	N/D														
Phenol	0.0	.140	.0773	.255	.0061	.0337														
BOD		2.4	5	8	3															
COD	44	4.4	51.5	<5	7	41														
TOC																				
Sodium						126														
Potassium						ND														
Calcium						202														
Magnesium						120														
Phosphorus P																				
Cadmium																				
Chromium	<.10	<.10	0.03	<.10	ND															
Copper	0.01	0.01	—	<.05	<.05															
Iron	0.75	1.51	2.35	<.05	0.9	<.05														
Lead																				
Manganese						<.1														
Nickel	<.05	<.05	—	<.02	ND															
Zinc	0.05	<.01	0.03	<.01																
Ammonia						0.82														
DOC						1.4														
Alkalinity						90														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 18: BH 13-III

Constituent mg/L	DATE D/M/YR 24/04 1984	17/07	15/10																	
Conductance	1300	1400	1400																	
pH	7.2	6.8	6.8																	
Chloride	73	84	92																	
Hardness	680	640	2690																	
Sulphate	531	550	580																	
Kjeldahl N	0.56	0.38	1.10																	
Nitrate	ND	1.23	0.05																	
Phenol		.0037	.004																	
BOD	5																			
COD	ND	7	31																	
TOC	—																			
Sodium		115	114																	
Potassium		ND	ND																	
Calcium		85	878																	
Magnesium		95	120																	
Phosphorus P																				
Cadmium																				
Chromium	ND																			
Copper	<.05																			
Iron	0.7	—	<.05																	
Lead																				
Manganese			<.1																	
Nickel	.02																			
Zinc	ND																			
Ammonia		—	0.78																	
DOC		3.2	1.2																	
Alkalinity		170	194																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 19A: BH 13-IV

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	1700 2100	1900	2000	2000	1900	900	1800	1550	1700	2100	1500	1600	1700	1850	-	1600	1550	1700	1600	1450
pH	8.2 7.9	7.0	7.5	7.2	7.3	7.3	7.6	7.5	7.3	7.6	7.6	7.4	7.6	7.2	-	6.6	7.1	6.9	6.9	7.7
Chloride	34 87	45	61	45	47	60	38	40	38	40	38	38	38	50	-	3	7	28	33	26
Hardness	806 1020													575						985
Sulphate	700 740													800						555
Kjeldahl N														0.5						2.08
Nitrate	<0.05													0.02						0.07
Phenol														0.134						0
BOD														0						
COD																				73
TOC	2.0 0.5																			
Sodium	144 59													75						
Potassium	27 2.9													3.3						
Calcium	237 152													165						
Magnesium	150 340													175						
Phosphorus P														3.12						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.08
Copper	N.D <0.05													N.D.						0.02
Iron	0.1 <0.05													2.4						2.2
Lead	0.2 <0.1													N.D.						
Manganese	0.1 1.00													1.2						
Nickel	N.D. <0.05													N.D.						0.01
Zinc	N.D. <0.01													0.03						0.02

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 19B: BH 13-IV

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	1600	1700	1720	1500	1000	1500														
pH	7.1	7.3	7.2	7.0	6.9	7.0														
Chloride	30	-	29	26	29	34														
Hardness	1081	1050	1160	1050	1080	2730														
Sulphate	650	810	610	630	531	580														
Kjeldahl N	1.82	2.2	0.74	0.92	0.80	1.9														
Nitrate	<0.01	0.01	<.01	0.1	ND	0.30														
Phenol	0.0	.123	.1142	.306		.0006														
BOD		4.9	3	43	3															
COD	44	14.7	<1.0	22	ND	29														
TOC																				
Sodium						54.4														
Potassium						.2														
Calcium						828														
Magnesium						160														
Phosphorus P																				
Cadmium																				
Chromium	<.10	<.10	0.05	<.10	ND															
Copper	0.80	0.02	0.05	<.05	<.05															
Iron	2.95	1.92	2.67	0.10	2.3	0.07														
Lead																				
Manganese						<.1														
Nickel	<.05	<.05	0.02	<.02	ND															
Zinc	0.04	0.06	0.01	<.02	ND															
Ammonia						.60														
DOC						1.4														
Alkalinity						418														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 20A: BH 14-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	23/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 2580	3100	3100	3800	3500	2400	2900	3000	3500	2700	2800	2800	2900	3000	2500	2780	2700	3100	3020	2900
pH	7.8 7.4	7.5	7.5	7.4	7.4	7.6	7.3	7.7	7.7	7.5	7.7	7.8	7.7	7.2	7.3	6.8	7.3	7.0	6.8	7.6
Chloride	220 201	255	242	242	244	300	227	243	227	336	281	303	258	235	265	226	220	215	218	217
Hardness	1460 1340													825						1702
Sulphate	1310 1190													1500						1530
Kjeldahl N	1.1 1.4													1.6						1.28
Nitrate	<0.05 <0.05													0						0.24
Phenol	0.004 0.034													0.211						0
BOD	15 27													0.1						
COD																				30
TOC	3.5 2.0																			
Sodium	164 127													150						
Potassium	8.0 10.5													3.5						
Calcium	200 291													410						
Magnesium	136 146													140						
Phosphorus P														0.12						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						<0.02
Copper	N.D. <0.05													N.D.						0.52
Iron	0.1 0.1													0.4						0.17
Lead	0.2 <0.1													N.D.						
Manganese	0.1 0.1													<0.1						
Nickel	N.D. 0.05													N.D.						0.18
Zinc	N.D. <0.01													N.D.						0.02

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 20B: BH 14-I

Constituent mg/L	DATE D/M/YR 31/10 1983	15/10 1984
Conductance	2200	2700
pH	6.8	6.8
Chloride	230	240
Hardness	1690	2192
Sulphate	1400	1398
Kjeldahl N	0.44	0.90
Nitrate	<.01	
Phenol	.082	.008
BOD	12	
COD	51	25
TOC		
Sodium		58.6
Potassium		10.6
Calcium		450
Magnesium		150
Phosphorus P		
Cadmium		
Chromium	<.10	
Copper	<.05	
Iron	0.26	0.06
Lead		
Manganese		0.10
Nickel	<.02	
Zinc	0.02	
Ammonia		1.00
DOC		1.5
Alkalinity		272

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 21B:BH 14-II

Constituent mg/L	DATE D/M/YR 31/10 1983	15/10 1984
Conductance		2200
pH		6.75
Chloride		176
Hardness		1636
Sulphate		1262
Kjeldahl N		1.4
Nitrate		
Phenol		ND
BOD		
COD		24
TOC		
Sodium		56.2
Potassium		3.1
Calcium		295
Magnesium		140
Phosphorus P		
Cadmium		
Chromium		
Copper		
Iron		0.18
Lead		
Manganese		0.13
Nickel		
Zinc		
Ammonia		0.82
DOC		2.3
Alkalinity		144

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 22A: BH 14-III

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	6500 6380	7000	9000	7000	6500	6000	6000	5500	7000	5200	5500	4750	6000	6000	3750	5500	4500	6000	2450	
pH	7.5 7.7	7.5	7.0	7.5	7.0	7.1	7.1	7.2	7.1	7.5	7.4	7.4	7.3	6.6	7.3	6.9	7.2	6.8	6.7	
Chloride	240 231	240	212	227	229	270	227	243	178	305	243	258	212	135	220	38	10	24	171	
Hardness	4150 4410													1885						
Sulphate	4075 4130													2750						
Kjeldahl N	0.58 0.44													0.8						
Nitrate	0.15 0.09													0.04						
Phenol	0.044 0.045													0.205						
BOD	– 1.0													0.2						
COD																				
TOC	2.5 1.0																			
Sodium	343 364													430						
Potassium	11.6 12.4													3.7						
Calcium	474 533													515						
Magnesium	805 845													700						
Phosphorus P														0.10						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.01													N.D.						
Copper	N.D. <0.05													N.D.						
Iron	6.5 0.10													5.4						
Lead	0.3 <0.10													N.D.						
Manganese	0.6 0.55													0.7						
Nickel	N.D. 0.10													N.D.						
Zinc	<0.1 0.02													0.03						

DAY

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 22B: BH 14-III

Constituent mg/L	DATE D/M/YR 31/10 1983	15/10 1984																		
Conductance	3600	3600																		
pH	6.9	6.6																		
Chloride	141	122																		
Hardness	3100	1484																		
Sulphate	2850	2421																		
Kjeldahl N	0.24	1.40																		
Nitrate	0.1	0.85																		
Phenol	.357	.020																		
BOD	10																			
COD	18	38																		
TOC																				
Sodium		260																		
Potassium		22.3																		
Calcium		450																		
Magnesium		320																		
Phosphorus P																				
Cadmium																				
Chromium	<.10																			
Copper	<.05																			
Iron	0.23	<.05																		
Lead																				
Manganese		0.14																		
Nickel	<.02																			
Zinc	0.03																			
Ammonia		0.50																		
DOC		2.9																		
Alkalinity		84																		

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 23: BH 17-I

Constituent mg/L	DATE D/M/YR																				
	PRE-DISPOSAL 1980	15/10 1981	18/10 1982	31/10 1983	15/10 1984																
Conductance	3200 3100	2700	2600	1600	2400																
pH	7.7 7.8	7.5	7.6	7.0	6.6																
Chloride	256 260	174	171	118	208																
Hardness	1600 1690		1390	1140	2284																
Sulphate	1510 1540		1285	925	1330																
Kjeldahl N	0.43 1.1		N.D.	0.0	0.4																
Nitrate	<0.05 <0.05		0.08	0.7	0																
Phenol	0.0065 0.022		N.D.	—	.005																
BOD	1.8 0.8			<1																	
COD			60	7	125																
TOC	1.0 <0.5																				
Sodium	348 170				61.6																
Potassium	5.2 5.0				4.1																
Calcium	495 391				445																
Magnesium	166 168				130																
Phosphorus P																					
Cadmium																					
Chromium			<0.01	<.10																	
Copper			0.03	<.05																	
Iron	0.08 0.34		0.07	0.14	<.05																
Lead																					
Manganese					0.50																
Nickel			0.02	<.02																	
Zinc			0.02	<.01																	
Ammonia					0.64																
DOC					1.7																
Alkalinity					244																

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 24: BH 17-II

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984															
Conductance	3100 2830	2300	2250	1400	1650															
pH	8.0 7.8	8.0	7.7	7.6	6.7															
Chloride	190 186	121	100	65	84															
Hardness	720 930		795	650	2948															
Sulphate	1100 1190		985	725	784															
Kjeldahl N	40 18		0.53	3.24	3.2															
Nitrate	0.14 <0.05		0.16	0.3	0.95															
Phenol	0.044 0.027		N.D.	.0204	.014															
BOD	15 7.3			<1																
COD			45	19	29															
TOC	2.5 0.5																			
Sodium	140 278				225															
Potassium	35 17				3.3															
Calcium	269 216				150															
Magnesium	76 104				60															
Phosphorus P																				
Cadmium																				
Chromium			<0.01	<.10																
Copper			0.03	<.05																
Iron	0.14 0.18		0.16	<.05																
Lead					0.13															
Manganese					0.30															
Nickel			0.01	<.02																
Zinc			0.01	<.01																
Ammonia					3.12															
DOC					2.2															
Alkalinity					154															

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 25: BH 17-III

Constituent mg/L	DATE D/M/YR																			
	PRE-DISPOSAL 1980	15/10 1981	19/10 1982	31/10 1983	15/10 1984															
Conductance	2350 2280	2200	1550	1300	1300															
pH	7.6 8.0	7.0	7.3	7.3	7.3															
Chloride	38 60	38	32	30	36															
Hardness	1100 1040		676	950	1216															
Sulphate	1150 1140		605	775	546															
Kjeldahl N	2.6 1.2		6.83	0.44	2.6															
Nitrate	0.30 0.33		3.17	0.1	1.2															
Phenol			N.D.	.816	0.013															
BOD				<1																
COD			22	51	49															
TOC	2.5 <0.5																			
Sodium	101 167				115															
Potassium	18 19				19.5															
Calcium	230 212				190															
Magnesium	142 133				80															
Phosphorus P																				
Cadmium																				
Chromium			0.01	<.10																
Copper			0.14	<.05																
Iron	0.21 0.82		3.17	0.06	<.05															
Lead																				
Manganese					<.1															
Nickel			0.04	<.02																
Zinc			0.04	0.02																
Ammonia					2.64															
DOC					1.4															
Alkalinity					184															

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 26A: BH 22-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 2680	2500	3000	-	2250	2800	2700	2100	2500	2400	2000	2400	3000	2900	2050	3200	3200	5500	850	600
pH	7.7 7.7	8.0	7.5	-	7.4	7.6	7.3	7.4	7.0	7.2	7.3	7.1	7.4	7.1	7.5	6.8	7.1	7.2	7.2	7.7
Chloride	260 205	150	217	-	186	240	159	152	167	380	243	281	243	260	258	112	10	81	112	53
Hardness	1400 1405													790						2250
Sulphate	1420 1310													1450						120
Kjeldahl N	0.62 0.70													1.8						0.24
Nitrate	<0.05 0.15													0.08						0.75
Phenol	0.0074 0.030													0.0026						0
BOD	1.7 0.5													0						
COD																				-
TOC	2.0 <0.5																			
Sodium	48 143													170						
Potassium	5.3 3.8													4.1						
Calcium	152 297													400						
Magnesium	155 159													135						
Phosphorus P														0.08						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.06
Copper	N.D. <0.05													N.D						<0.01
Iron	0.4 0.15													0.6						0.24
Lead	0.1 <0.10													N.D.						
Manganese	0.4 0.20													0.3						
Nickel	N.D. <0.05													N.D.						0.13
Zinc	N.D. <0.01													0.04						<0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 26B: BH 22-I

Constituent mg/L	DATE D/M/YR																				
	28/01/1983	26/04	28/07	31/10	24/04/1984	15/10															
Conductance		1350		900																	
pH		7.5		7.2																	
Chloride		–		69																	
Hardness		750		600																	
Sulphate		670		365																	
Kjeldahl N		4.8		2.08																	
Nitrate		0.07		0.7																	
Phenol		–		.102																	
BOD		–		8																	
COD	2	176		75																	
TOC	E		E		E	E															
Sodium	N		J		L	L															
Potassium	O		C		C	C															
Calcium	R		E		E	E															
Magnesium	F		A		A	A															
Phosphorus P			S		S	S															
Cadmium																					
Chromium		<.10		<.10																	
Copper		0.07	O	<.05	O	O															
Iron		32.0	F	0.13	N	N															
Lead																					
Manganese																					
Nickel		<.05		<.02																	
Zinc		0.42		0.07																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 27A: BH 26-III

Constituent mg/L	DATE D/M/YR																			
	31/01 1984	24/04	17/07	15/10																
Conductance		2100	2750																	
pH	↑	7.0	7.0	↑																
Chloride		33	13																	
Hardness		1800	1760																	
Sulphate		1625	1550																	
Kjeldahl N		ND	0.30																	
Nitrate		3.10	3.17																	
Phenol		.012	.015																	
BOD		2																		
COD	↓	15	8	↓																
TOC	R			R																
Sodium	O		155	O																
Potassium			ND																	
Calcium			210																	
Magnesium			255																	
Phosphorus P																				
Cadmium																				
Chromium		ND																		
Copper		ND																		
Iron		0.1																		
Lead																				
Manganese																				
Nickel	↓	ND		↓																
Zinc		ND																		
Ammonia																				
DOC			3.9																	
Alkalinity			370																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 27B: BH 22-II

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	290	I.S		900																
pH	7.4	7.8	↑	6.9	↑	↑														
Chloride	30	I.S		90																
Hardness	142	I.S		590																
Sulphate	62	I.S		334																
Kjeldahl N	<0.10	I.S		2.0																
Nitrate	1.11	I.S		—																
Phenol	0.0	I.S		—																
BOD				8																
COD	51	I.S	W	118	W	W														
TOC			A		A	A														
Sodium			S		S	S														
Potassium			T		T	T														
Calcium			E		E	E														
Magnesium			R		R	R														
Phosphorus P																				
Cadmium																				
Chromium	<.10	<.10	0	<.10	0	0														
Copper	0.02	0.10	N	<.05	N	N														
Iron	1.00	15.4	↓	<.05	↓	↓														
Lead																				
Manganese																				
Nickel	<.05	<.05		<.02																
Zinc	<.01	0.20	↓	0.11	↓	↓														

I.S. – insufficient sample

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 28A: BH 24-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	3200 3170	3500	3600	4000	3750	3300	3200	3000	3500	2600	2600	2600	3500	3100	2300	2610	2500	2900	2800	2950
pH	7.7 7.7	7.5	7.7	7.5	7.5	7.6	7.8	7.6	7.1	7.5	8.0	7.3	7.4	7.3	7.7	6.9	7.5	7.4	7.0	7.3
Chloride	247 549	300	273	280	227	270	182	280	243	330	296	303	258	275	281	238	237	215	241	230
Hardness	1600 1630													830						1209
Sulphate	1700 1800													1550						1430
Kjeldahl N	0.7 0.51													1.2						1.40
Nitrate	0.62 <0.1													0.03						0
Phenol	0.034 0.022													0.012						0
BOD	38 10													3.0						
COD																				—
TOC	4.0 5.4																			
Sodium	146 138													165						
Potassium	18.6 18.4													4.1						
Calcium	315 342													435						
Magnesium	208 188													155						
Phosphorus P														0.20						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.02
Copper	N.D. <0.05													—						0.09
Iron	0.1 0.1													0.3						0.30
Lead	0.1 0.1													0.3						
Manganese	0.1 <0.10													0.1						
Nickel	N.D. 0.05													N.D.						0.03
Zinc	N.D. 0.02													N.D.						0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 28B: BH 24-I

Constituent mg/L	DATE D/M/YR																				
	28/01 1983	26/04	28/07	31/10	24/04 1984	17/07	15/10														
Conductance	2700	2800	2940	2100	2600		2650														
pH	6.9	7.2	7.25	7.3	6.9		6.7														
Chloride	220	230	245	235	230		226														
Hardness	1918	1650	1550	1620	2040		2580														
Sulphate	1425	1175	1675	1350	1343		955														
Kjeldahl N	0.10	0.32	0.14	1.28	0.94		2.7														
Nitrate	<0.01	0.01	<.01	1.2	ND		0.75														
Phenol	0.0	–	.017	.043	.006		0.010														
BOD		–	1	<1	ND																
COD	29	67	43	<5	7		41														
TOC					–	SEE															
Sodium							166														
Potassium							3.8														
Calcium							702														
Magnesium							200														
Phosphorus P																					
Cadmium																					
Chromium	<.10	<.10	0.06	<.10	ND																
Copper	0.13	<.01	0.09	<.05	0.48																
Iron	0.59	4.8	0.88	<.05	2.5		<.05														
Lead																					
Manganese							<.1														
Nickel	<.05	<.05	0.04	<.02	ND																
Zinc	0.02	0.02	–	<.01	ND																
Ammonia							1.80														
DOC							2.1														
Alkalinity							220														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 29A: BH 24-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	13/10 1982
Conductance	4300 4500	5000	5200	6000	5000	3800	4000	3400	5000	3300	3500	3250	4300	2900	2600	3120	3100	3500	3520	3450
pH	7.6 7.4	7.0	7.5	7.2	7.2	7.2	7.5	7.3	7.0	7.5	7.5	7.2	7.3	6.7	7.3	6.9	7.3	6.9	6.9	7.7
Chloride	123 78	75	91	83	84	120	61	68	61	92	68	67	53	50	45	7	8	37	58	53
Hardness	2000 2370													1305						2252
Sulphate	2900 3000													2300						1945
Kjeldahl N	0.75 0.63													0						1.28
Nitrate	1.6 <0.1													0.06						0
Phenol	0.034 0.024													0						0
BOD	30 23													0						
COD																				15
TOC	2.0 12																			
Sodium	360 260													150						
Potassium	29 15.4													3.5						
Calcium	445 435													410						
Magnesium	268 377													400						
Phosphorus P														0.02						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.15
Copper	N.D. <0.05													N.D.						0.72
Iron	12.0 6.0													10.5						5.0
Lead	0.2 <0.10													N.D.						
Manganese	0.6 0.5													0.5						
Nickel	<0.1 0.5													N.D.						0.06
Zinc	0.1 0.04													N.D.						0.05

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 29B: BH 24-II

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	3300	3200	3380	2100	2800	2900														
pH	7.0	7.0	6.9	6.9	6.9	7.1														
Chloride	40	43.0	40	39	43	50														
Hardness	2507	2250	2320	2170	2140	2660														
Sulphate	2150	1750	2150	1870	1781	1603														
Kjeldahl N	0.44	0.52	1.0	1.16	0.44	0.70														
Nitrate	<0.01	0.02	<.01	<.01	ND	0.40														
Phenol	0.0	.035	.0163	-	0.010	ND														
BOD		-	1	8	3															
COD	15	14.7	<1.0	<5	ND	12														
TOC					-															
Sodium						144														
Potassium						11.5														
Calcium						180														
Magnesium						360														
Phosphorus P																				
Cadmium																				
Chromium	<.10	<.10	0.02	<.10	ND															
Copper	0.06	0.06	0.04	<.05	ND															
Iron	5.86	14.9	10.7	0.45	7.6	<.05														
Lead																				
Manganese						0.28														
Nickel	<.05	<.05	0.01	<.02	ND															
Zinc	0.10	<.01	0.04	0.01	ND															
Ammonia						0.50														
DOC						2.5														
Alkalinity						500														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 30A: BH 24-III

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	4300 4050	4500	5000	6000	4000	3800	3500	3250	3600	3000	3000	3000	4000	3350	2500	3260	3000	3820	3680	3200
pH	7.4 7.6	7.0	7.0	7.1	7.2	7.1	7.4	7.3	7.1	7.0	7.2	7.3	7.3	6.7	7.3	6.9	7.2	6.8	6.9	7.6
Chloride	38 1065	45	61	53	49	90	40	40	38	61	45	45	38	35	45	5	8	37	40	21
Hardness	2800 2450													1150						2275
Sulphate	3200 3800													1950						1945
Kjeldahl N	0.41 0.22													0.80						2.08
Nitrate	0.18 0.15													0.35						0.55
Phenol	0.024 0.022													0						0
BOD	24 2.8													0						
COD																				14
TOC	4.0 7.9																			
Sodium	214 144													120						
Potassium	16.9 7.1													3.7						
Calcium	445 444													255						
Magnesium	440 437													380						
Phosphorus P														0.10						
Cadmium														N.D.						
Chromium														N.D.						0.02
Copper														N.D.						0.05
Iron														3.7						2.7
Lead														N.D.						
Manganese														0.5						
Nickel														N.D.						<0.01
Zinc														N.D.						<0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 30B: BH 24-III

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	17/07	15/10													
Conductance	2700	2650	2820	2000	2200	2700	1900													
pH	7.0	7.0	6.95	6.9	6.9	6.7	6.75													
Chloride	25	4.5	2.5	23	18	23	18													
Hardness	2180	1840	1930	1850	1850	1950	972													
Sulphate	1700	1475	1765	1420	1375	1530	1023													
Kjeldahl N	0.26	0.16	0.14	1.40	0.56	0.16	0.50													
Nitrate	0.63	0.22	<.01	0.1	0.1	ND	0													
Phenol	0.0	.026	.0122	—	.020	.007	ND													
BOD		—	14	20	1															
COD	15	11.8	2.9	<5	ND	ND	26													
TOC					—															
Sodium						120	28.2													
Potassium						ND	6.5													
Calcium						100	98													
Magnesium						300	210													
Phosphorus P																				
Cadmium																				
Chromium	0.10	<.10	0.08	<.10	ND															
Copper	0.02	0.04	0.04	<.05	ND															
Iron	3.01	3.1	3.5	<.05	2.4		0.13													
Lead																				
Manganese							<.1													
Nickel	<.05	<.05	0.03	<.02	ND															
Zinc	0.02	<.01	0.05	0.01	ND															
Ammonia							0.6													
DOC						24	—													
Alkalinity						390	320													

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 31A: BH 25-I

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 2850	3100	3400	3500	3000	1900	2800	2700	2600	2500	2300	2300	2750	2100	2050	2370	2250	2600	2680	2750
pH	7.6 7.5	7.5	7.7	7.3	7.6	7.4	7.9	7.8	7.5	7.6	7.4	7.5	7.5	7.2	7.8	6.4	7.5	7.1	7.2	7.7
Chloride	147 149	180	182	174	152	210	175	197	152	180	190	205	167	190	159	145	138	142	141	142
Hardness	1900 1590													735						1581
Sulphate	1900 1700													1450						1285
Kjeldahl N	0.68 0.97													1.6						1.04
Nitrate	0.10 <0.1													0.02						0.05
Phenol	0.039 0.025													0.049						0
BOD	107 5.3													0.1						
COD																				22
TOC	4.0 4.0																			
Sodium	134 120													150						
Potassium	9.0 4.6													3.5						
Calcium	268 329													310						
Magnesium	157 174													155						
Phosphorus P														0.08						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.08
Copper	N.D. <0.05													N.D.						0.34
Iron	0.8 <0.05													0.5						0.58
Lead	0.1 0.20													N.D.						
Manganese	0.1 <0.10													<0.1						
Nickel	N.D. <0.05													N.D.						0.03
Zinc	<0.1 <0.01													0.02						0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 31B: BH 25-I

Constituent mg/L	DATE D/M/YR					
	8/01 1983	26/04	28/07	31/10	24/04 1984	15/10
Conductance	↑	2450	2650	2300	2500	2400
pH	↕	7.25	7.25	7.2	7.0	6.9
Chloride	↕	152.0	156.0	144	160	148
Hardness	↕	1270	1330	1380	1330	1350
Sulphate	↕	1150	1352	1230	1343	1228
Kjeldahl N	↕	0.92	0.50	0.92	1.53	0.70
Nitrate	↕	0.01	<.01	0.1	ND	0
Phenol	↕	–	.049	.265	.002	.001
BOD	↕	0.4	1	20	1	
COD	↕	7.4	2.9	12	0	15
TOC	↕				–	
Sodium	↕					205
Potassium	↕					9.0
Calcium	↕					275
Magnesium	↕					140
Phosphorus P	↕					
Cadmium	↕					
Chromium	↕	<.10	0.06	<.10	ND	
Copper	↕	0.01	0.05	<.05	ND	
Iron	↕	1.1	2.1	<.05	1.2	0.1
Lead	↕					
Manganese	↕					<.1
Nickel	↕	<.05	0.02	<.02	ND	
Zinc	↕	<.01	0.02	0.01	ND	
Ammonia	↓					0.90
DOC						1.1
Alkalinity						62

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 32A: BH 25-II

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	23/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	2900 4700	5800	6000	6000	6000	1000	5500	5000	6000	5000	5500	4750	6500	6000	4900	6000	4500	6500	6500	6000
pH	7.6 7.9	7.0	7.0	7.2	7.1	6.8	7.4	7.3	7.0	7.3	7.1	7.1	7.2	6.5	7.0	6.6	7.1	6.8	6.8	7.4
Chloride	143 143	113	152	121	98	150	106	106	98	120	106	106	83	80	91	30	10	21	15	3
Hardness	1500 2840													2350						5460
Sulphate	1600 3200													3250						4585
Kjeldahl N	0.95 0.47													0.8						1.28
Nitrate	<0.1 <0.1													0.02						0.22
Phenol	0.026 0.024													0.059						0
BOD	5.2													0						
COD																				441
TOC	2.5 5.2																			
Sodium	148 164													255						
Potassium	9.5 9.0													3.3						
Calcium	294 355													475						
Magnesium	19.8 565													970						
Phosphorus P														0.42						
Cadmium	N.D. <0.01													N.D.						
Chromium	N.D. <0.02													N.D.						0.11
Copper	N.D. <0.05													N.D.						0.66
Iron	<0.1 0.10													0.6						2.2
Lead	0.2 <0.10													N.D.						
Manganese	2.2 2.3													2.5						
Nickel	0.1 0.13													N.D.						0.07
Zinc	<0.1 0.01													N.D.						0.16

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 32B: BH 25-II

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	6000	3250	3850	4000	2500	2900														
pH	6.7	7.1	7.0	6.9	7.0	6.75														
Chloride	65	5.9	1.5	32	11	26														
Hardness	5640	3100	2900	3420	2160	1864														
Sulphate	5100	2300	1600	2820	1718	1910														
Kjeldahl N	0.46	–	0.29	0.32	0.80	0.40														
Nitrate	0.11	0.30	0.04	0.2	0.40	0.40														
Phenol	0.0	.090	.0939	.082	ND	.012														
BOD		–	2.0	<1	3															
COD	29	7.4	<1.0	12	0	26														
TOC					–															
Sodium						102														
Potassium						10.0														
Calcium						155														
Magnesium						400														
Phosphorus P																				
Cadmium																				
Chromium	0.20	<.10	0.04	<.10	ND															
Copper	0.13	0.01	0.07	<.05	ND															
Iron	0.64	0.35	3.7	<.05	0.2	<.05														
Lead																				
Manganese						<.1														
Nickel	0.06	<.05	0.01	<.02	ND															
Zinc	0.03	<.01	0.04	0.03	ND															
Ammonia						0.50														
DOC						2.80														
Alkalinity						430														

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 33A: BH 25-III

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	7200 7500	8000	10000	7000	8000	-	3000	2600	2800	2400	2900	2900	3000	2700	1900	2500	1900	2500	2850	3200
pH	7.4 7.8	7.5	7.3	7.5	7.0	-	7.7	7.5	7.3	7.8	7.4	7.4	7.3	6.9	7.5	6.6	7.5	7.2	7.0	7.7
Chloride	57 50	57	61	106	61	-	23	23	15	30	30	30	23	60	15	2	8	5	14	1
Hardness	5400 5490													975						2225
Sulphate	6000 6600													1550						1760
Kjeldahl N	1.07 0.35													0.5						1.04
Nitrate	0.27 <0.1													1.75						0.98
Phenol	0.023 0.023													0.092						0
BOD	9 1.9													0						
COD																				37
TOC	3.5 7.5																			
Sodium	274 250													155						
Potassium	17.9 13.2													3.1						
Calcium	445 395													320						
Magnesium	590 1252													135						
Phosphorus P														0.32						
Cadmium														N.D.						
Chromium														N.D.						0.09
Copper														-						0.04
Iron														1.3						1.2
Lead														N.D.						
Manganese														<0.1						
Nickel														N.D.						<0.01
Zinc														N.D.						<0.01

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 33B: BH 25-III

Constituent mg/L	DATE D/M/YR																			
	28/01/1983	26/04	28/07	31/10	24/04/1984	17/07	15/10													
Conductance	2050	2150	2600	2300	2000	2800	2900													
pH	6.8	7.25	7.15	7.1	7.1	6.9	6.8													
Chloride	55	1.4	1.0	8	6	17	12													
Hardness	1722	1550	1770	1820	1980	1980	2404													
Sulphate	1250	1075	1425	1260	1375	1530	1773													
Kjeldahl N	0.48	0.32	0.71	0.32	2.40	ND	0.4													
Nitrate	1.95	0.21	0.20	1.6	0.3	0.73	0.25													
Phenol	0.0	.061	.102	—	.010	.003	.014													
BOD		0.4	1.0	< 1	1															
COD	29	11.8	17.6	< 5	0	3	29													
TOC					—															
Sodium						100	104													
Potassium						ND	11.5													
Calcium						165	195													
Magnesium						345	420													
Phosphorus P																				
Cadmium																				
Chromium	< .10	< .10	0.04	< .10	ND															
Copper	0.03	< .01	0.08	< .05	ND															
Iron	1.12	0.33	0.87	< .05	0.9		< .05													
Lead																				
Manganese							< .1													
Nickel	< .05	< .05	—	< .02	ND															
Zinc	0.02	0.01	0.01	0.03	ND															
Ammonia							0.48													
DOC						6.2	2.9													
Alkalinity						380	426													

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 34A: BH 25-AI

Constituent mg/L	DATE D/M/YR																		
	PRE-DISPOSAL 1980	27/10 1980	28/11	23/12 1980	05/02 1981	02/03	25/03	29/04	22/05	25/06	29/07	07/08	29/09	15/10 1981	25/03 1982	26/05	22/06	30/07	25/08	19/10 1982
Conductance	5100 –	6000	6000	7000	6000	3500	5000	4500	5000	4000	5000	4000	5500	–	3300	4500	3500	4400	–	4300
pH	7.1 –	7.0	7.0	7.3	7.1	6.9	7.5	7.1	7.0	7.0	7.0	7.1	7.1	–	7.0	6.8	7.1	6.5	–	6.7
Chloride	76 –	98	121	106	91	135	98	121	91	122	99	106	76	–	83	8	6	66	–	1
Hardness	3600 –																			3115
Sulphate	3400 –																			2640
Kjeldahl N	0.73 –																			10.13
Nitrate	0.64 –																			0.06
Phenol	0.067 –																			0
BOD																				
COD																				59
TOC	3.0 –																			
Sodium	194 –																			
Potassium	11.1 –																			
Calcium	400 –																			
Magnesium	640 –																			
Phosphorus P																				
Cadmium	N.D. 0.02																			
Chromium	N.D. <0.02																			0.10
Copper	N.D. <0.05																			0.11
Iron	0.4 5.8																			3.6
Lead	<0.1 1.30																			
Manganese	1.2 2.10																			
Nickel	<0.1 0.07																			0.02
Zinc	<0.1 0.75																			0.03

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 34B: BH 25-AI

Constituent mg/L	DATE D/M/YR																			
	28/01 1983	26/04	28/07	31/10	24/04 1984	15/10														
Conductance	4500	4400	4850	4100	3800	3450														
pH	6.8	6.65	6.6	6.8	6.8	6.9														
Chloride	55	78.0	21.0	135	64	66														
Hardness	3760	3460	3570	3410	3380	1892														
Sulphate	3150	2700	3050	2760	2718	2285														
Kjeldahl N	2.68	1.76	8.56	6.12	3.12	10.50														
Nitrate	<0.01	0.02	0.01	0.3	1.20	0.15														
Phenol	0.0	—	.0408	.357	.006	.027														
BOD		4.9	22.0	24.0	5															
COD	30	17.6	51.5	40.0	0	62														
TOC					—															
Sodium						144														
Potassium						15														
Calcium						310														
Magnesium						440														
Phosphorus P																				
Cadmium																				
Chromium	0.2	<.10	0.05	<0.01	ND															
Copper	0.06	0.06	—	<0.05	ND															
Iron	1.51	2.02	2.72	0.2	4.2	0.15														
Lead																				
Manganese						<.1														
Nickel	<0.05	<.05	—	—	ND															
Zinc	0.02	0.08	0.01	0.01	ND															
Ammonia						6.32														
DOC						3.7														
Alkalinity						596														

GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 35A: BH 26-I

Constituent mg/L	DATE D/M/YR																			
	31/01/1984	24/04	15/10																	
Conductance	2625	2100	3100																	
pH	7.0	7.0	6.95																	
Chloride	180	183	192																	
Hardness	1740	1760	1972																	
Sulphate	1650	1531	1739																	
Kjeldahl N	2.24	3.60	2.2																	
Nitrate	0.01	ND	0																	
Phenol	.010	.010	ND																	
BOD	8.2	31																		
COD	353	132	116																	
TOC																				
Sodium			270																	
Potassium			18.5																	
Calcium			400																	
Magnesium			220																	
Phosphorus P																				
Cadmium																				
Chromium	ND	ND																		
Copper	ND	ND																		
Iron	0.14	1.4	<.05																	
Lead																				
Manganese			<.1																	
Nickel	ND	ND																		
Zinc	0.17	ND																		
Ammonia			1.8																	
DOC			10.9																	
Alkalinity			154																	

GLANBROOK SANIT[illegible] LANDFILL SITE
WATER C[illegible]MISTRY

TABLE 36A: BH 26-~~III~~ II

Constituent mg/L	DATE D/M/YR																			
	31/01 1984	29/04	15/10																	
Conductance	2375	2400	2600																	
pH	7.0	6.9	6.9																	
Chloride	170	188	200																	
Hardness	1430	1700	1668																	
Sulphate	1250	1281	1159																	
Kjeldahl N	1.28	1.60	7.50																	
Nitrate	0.01	ND	0																	
Phenol	.008	.006	.001																	
BOD	6.8	2																		
COD	29	15	91																	
TOC																				
Sodium			159																	
Potassium			12.5																	
Calcium			360																	
Magnesium			190																	
Phosphorus P																				
Cadmium																				
Chromium	ND	ND																		
Copper	ND	ND																		
Iron	0.12	1.2	0.19																	
Lead																				
Manganese			0.52																	
Nickel	ND	ND																		
Zinc	ND	ND																		
Ammonia			1.2																	
DOC			10.9																	
Alkalinity			180																	

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 38: UPSTREAM BUCKHORN CREEK

Constituent mg/L	DATE D/M/YR																			
	19/10/1982	28/01/1983	31/10	16/05/1984	14/11															
Conductance	1800	1200	420	545	500															
pH	7.1	7.2	6.5	7.0	6.1															
Chloride	64	47	35	19	22.5															
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				
Dissolved Oxygen	10.8	10.2	6.7		13.4															

REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
GLANBROOK SANITARY LANDFILL SITE
WATER CHEMISTRY

TABLE 39. BUCKHORN CREEK AT TOWNLINE ROAD

Constituent mg/L	DATE D/M/YR																			
	13/10 1982	28/01 1983	31/10	16/05 1984	14/11															
Conductance	1050	1400	700	713	600															
pH	6.9	7.0	6.7	7.1	6.3															
Chloride	168	74	56	37	27.5															
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate																				
Phenol																				
BOD																				
COD																				
TOC																				
Sodium																				
Potassium																				
Calcium																				
Magnesium																				
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				
Dissolved Oxygen	10.2	11.8	10.2		13.0															

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GLANBROOK SANI LANDFILL SITE
WATER CHEMISTRY

TABLE 40: DOWNSTREAM BUCKHORN CREEK

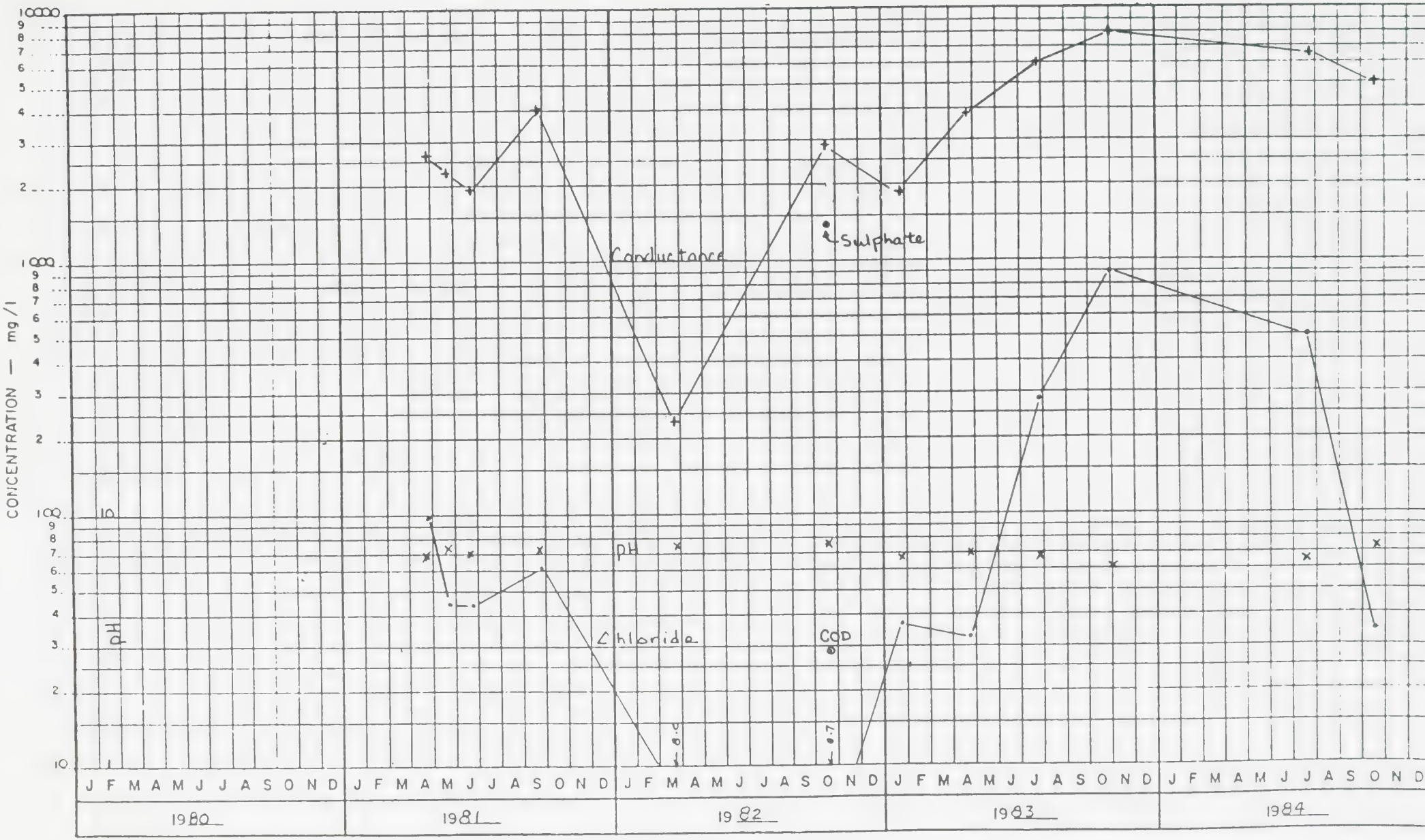
Constituent mg/L	DATE D/M/YR																			
	19/10 1982	28/01 1983	31/10	16/05 1984	14/11															
Conductance	1200		660	772	650															
pH	6.9		7.3	7.3	6.4															
Chloride	86		53	40	36															
Hardness																				
Sulphate																				
Kjeldahl N																				
Nitrate		W																		
Phenol		J																		
BOD		D																		
COD		E																		
TOC		A																		
Sodium		S																		
Potassium																				
Calcium		O																		
Magnesium		N																		
Phosphorus P																				
Cadmium																				
Chromium																				
Copper																				
Iron																				
Lead																				
Manganese																				
Nickel																				
Zinc																				
Dissolved Oxygen	9.2		11.3		13.4															

APPENDIX C

GRAPHS

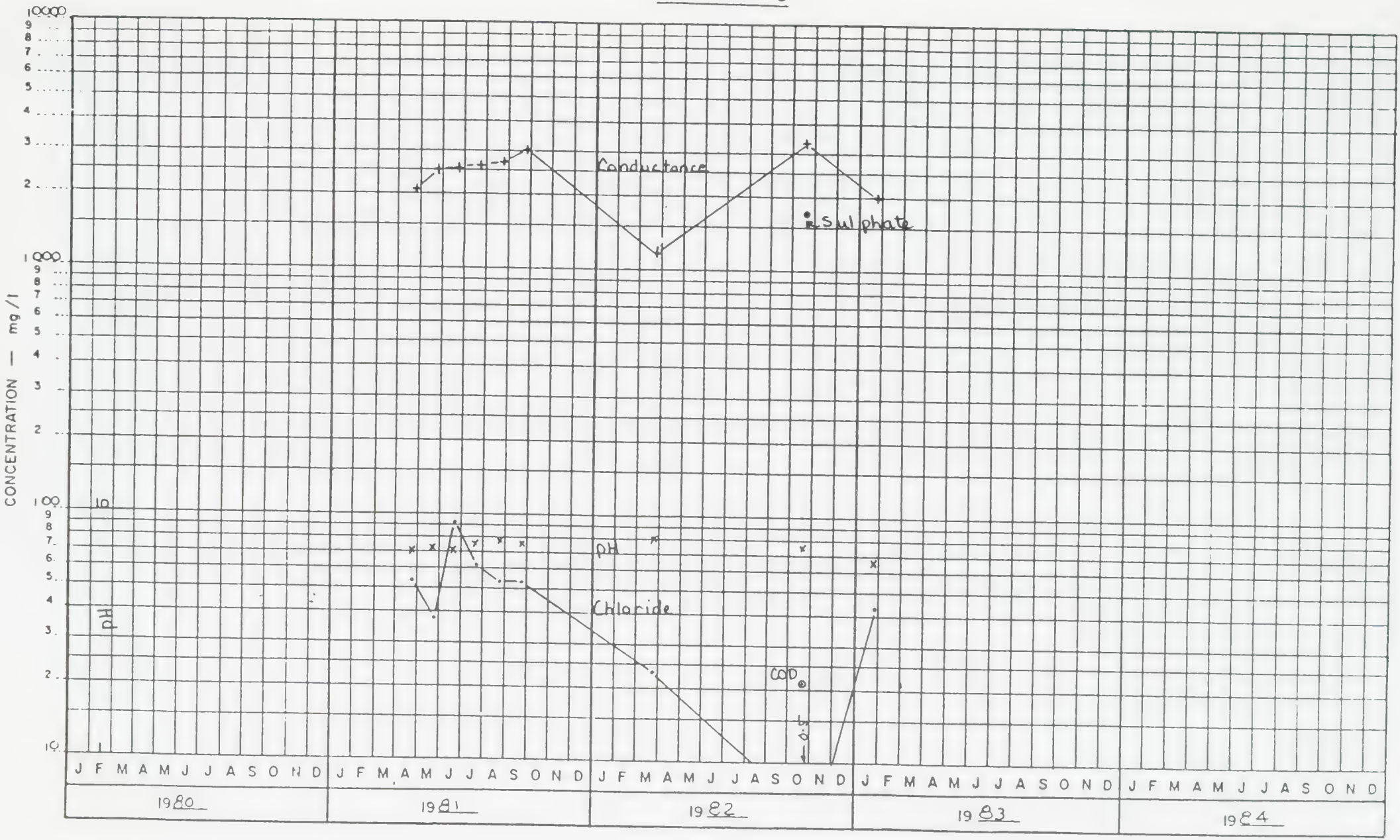
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

MANHOLE 1



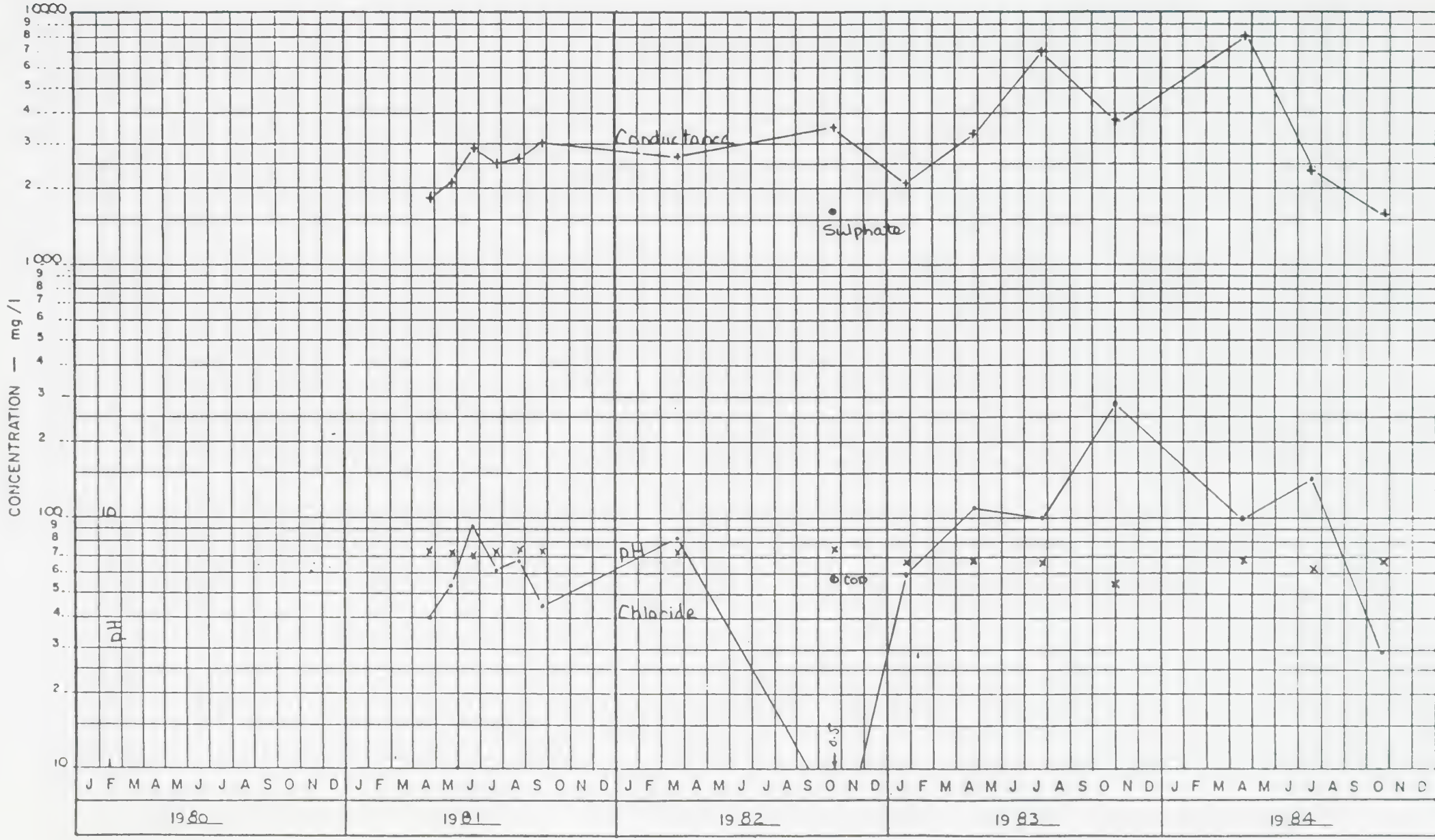
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

MANHOLE 3



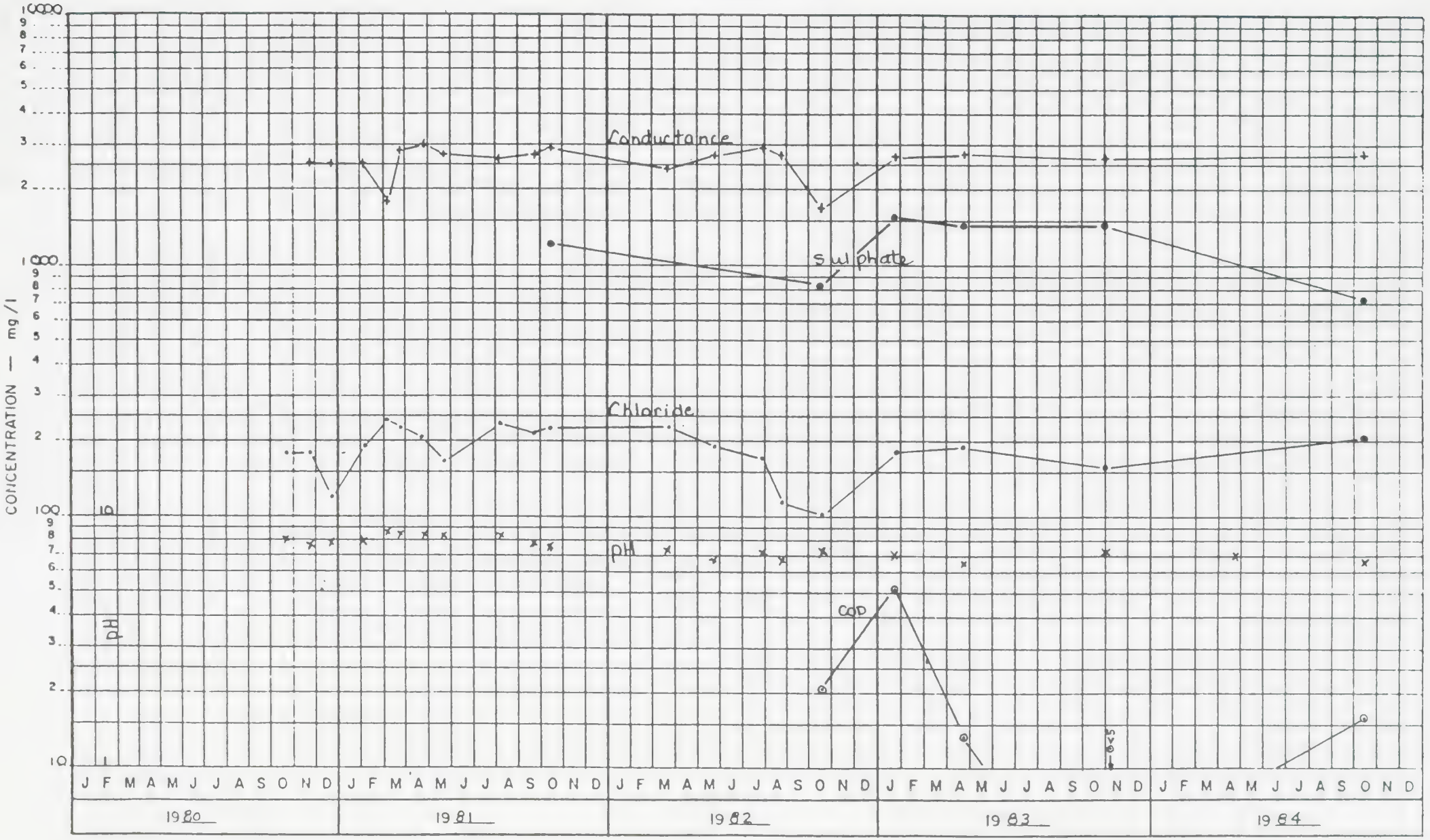
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

MANHOLE 4



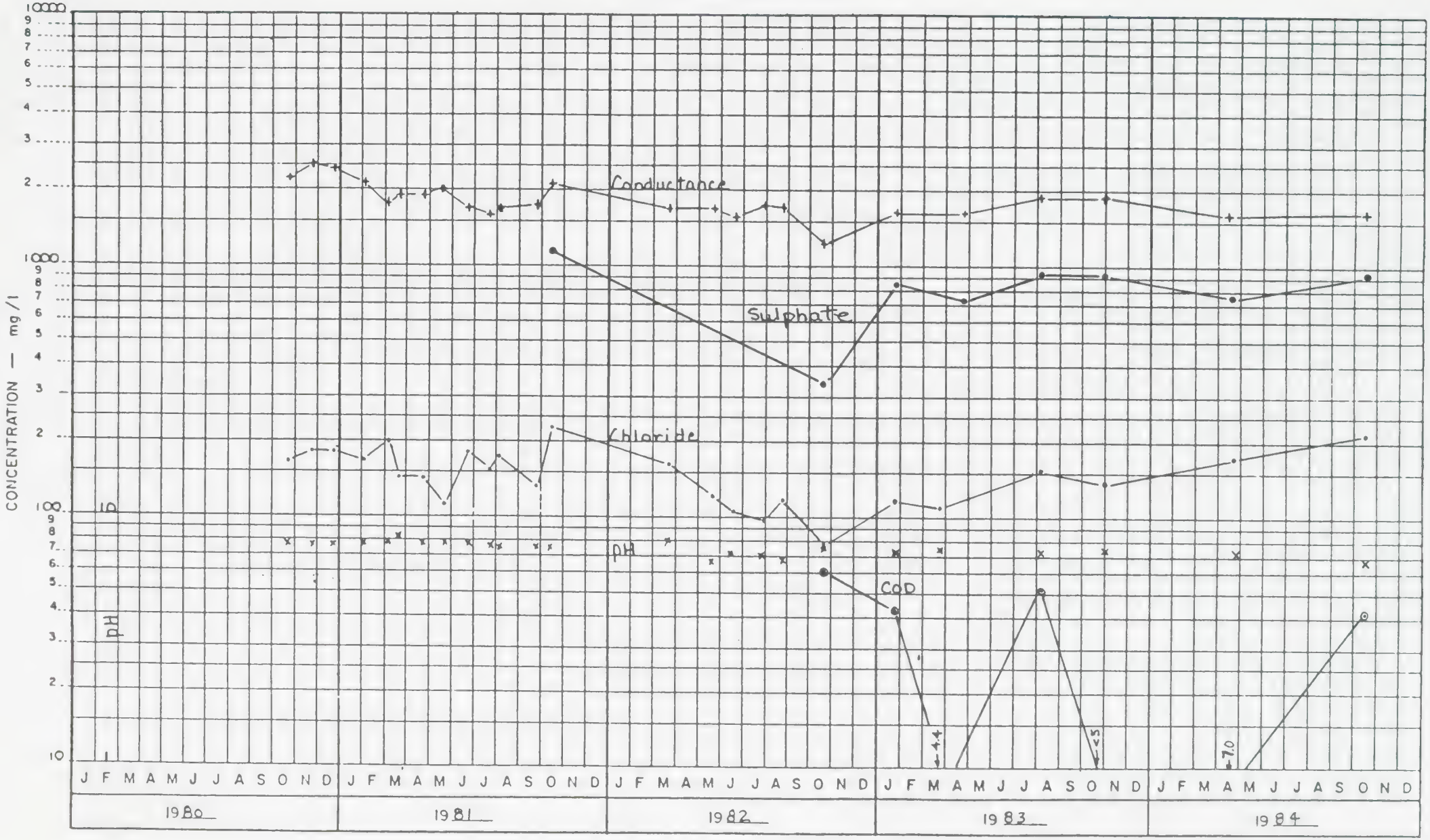
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 13-I



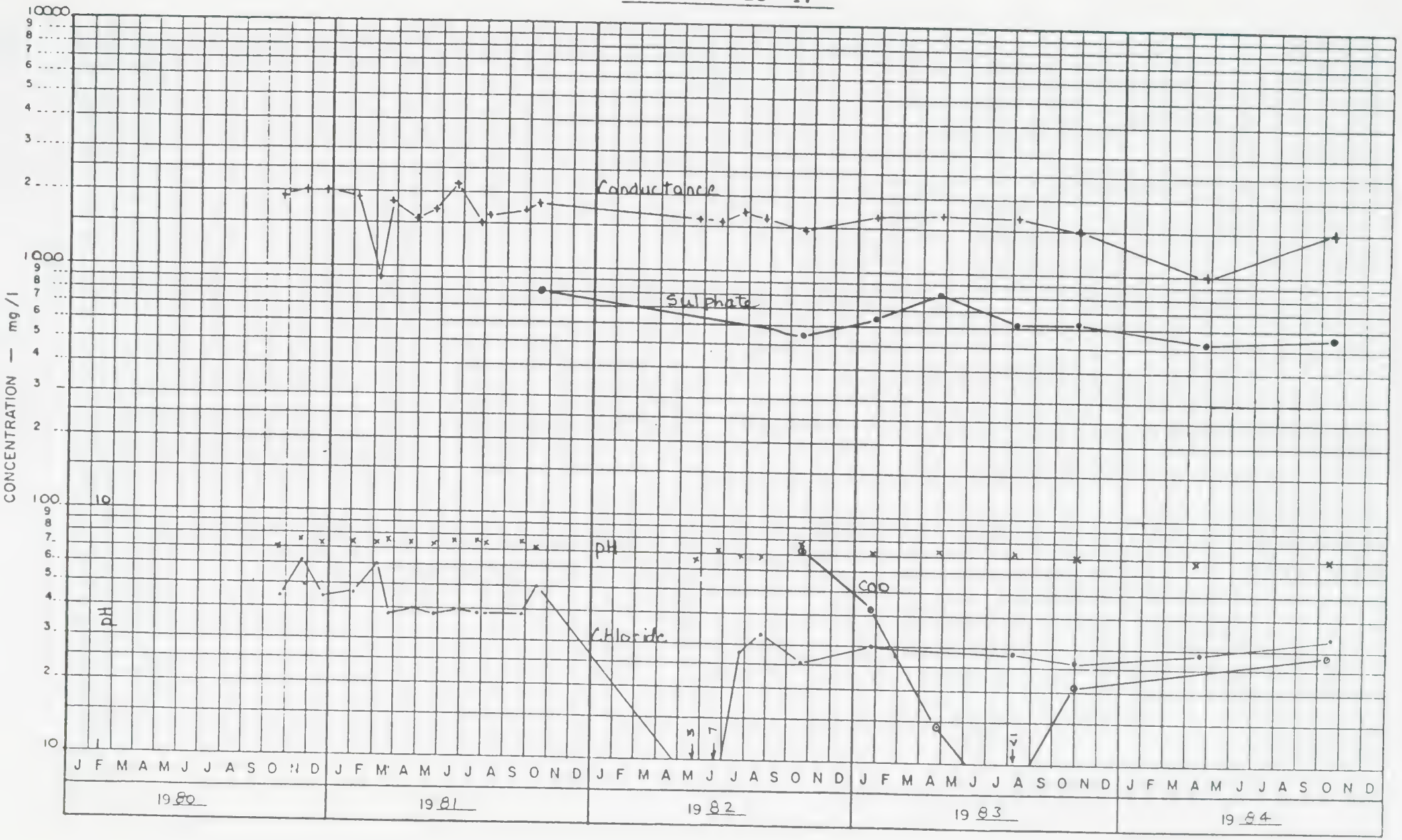
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 13-11



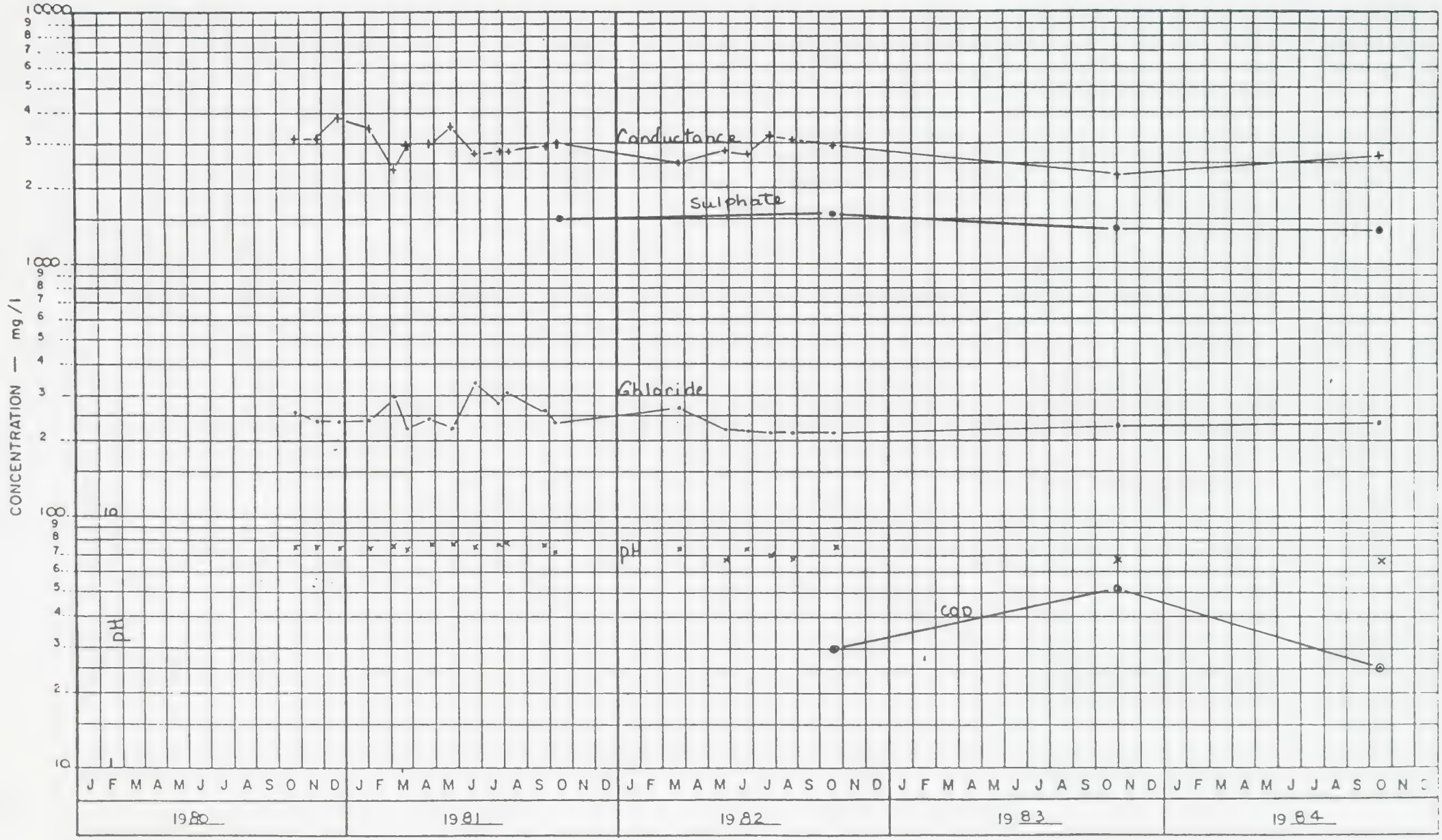
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 13- IV



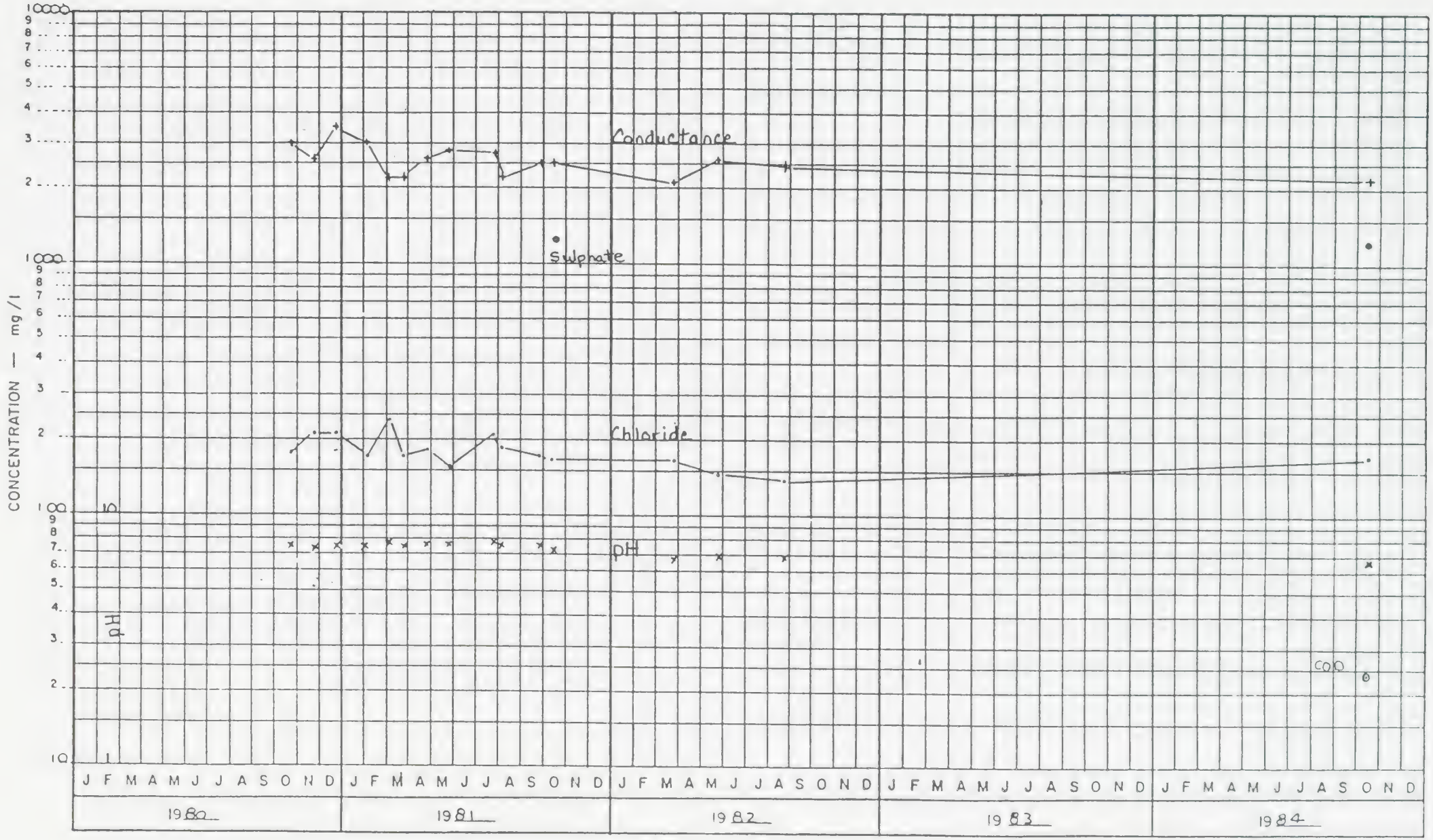
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHILE 14-I



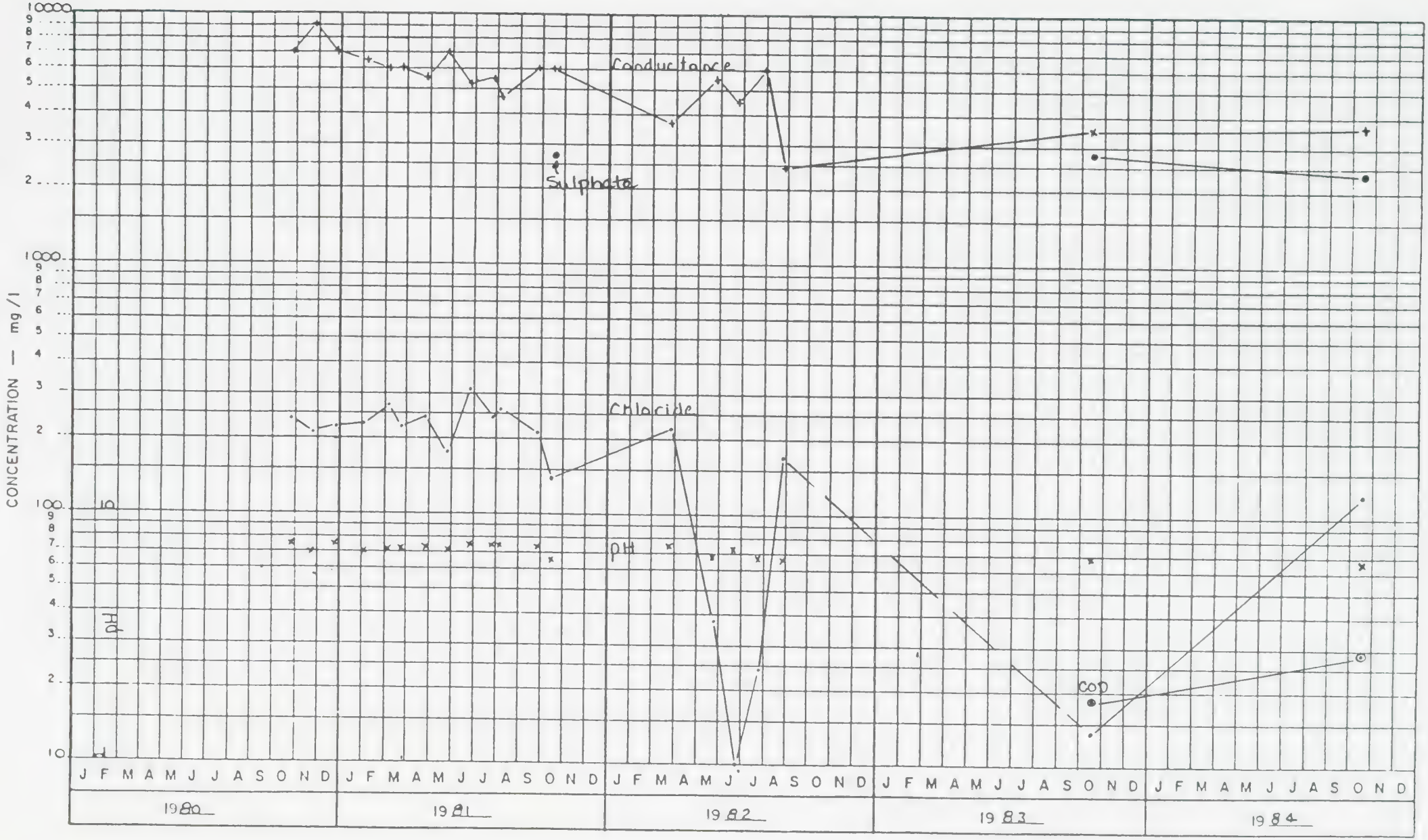
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 14-II



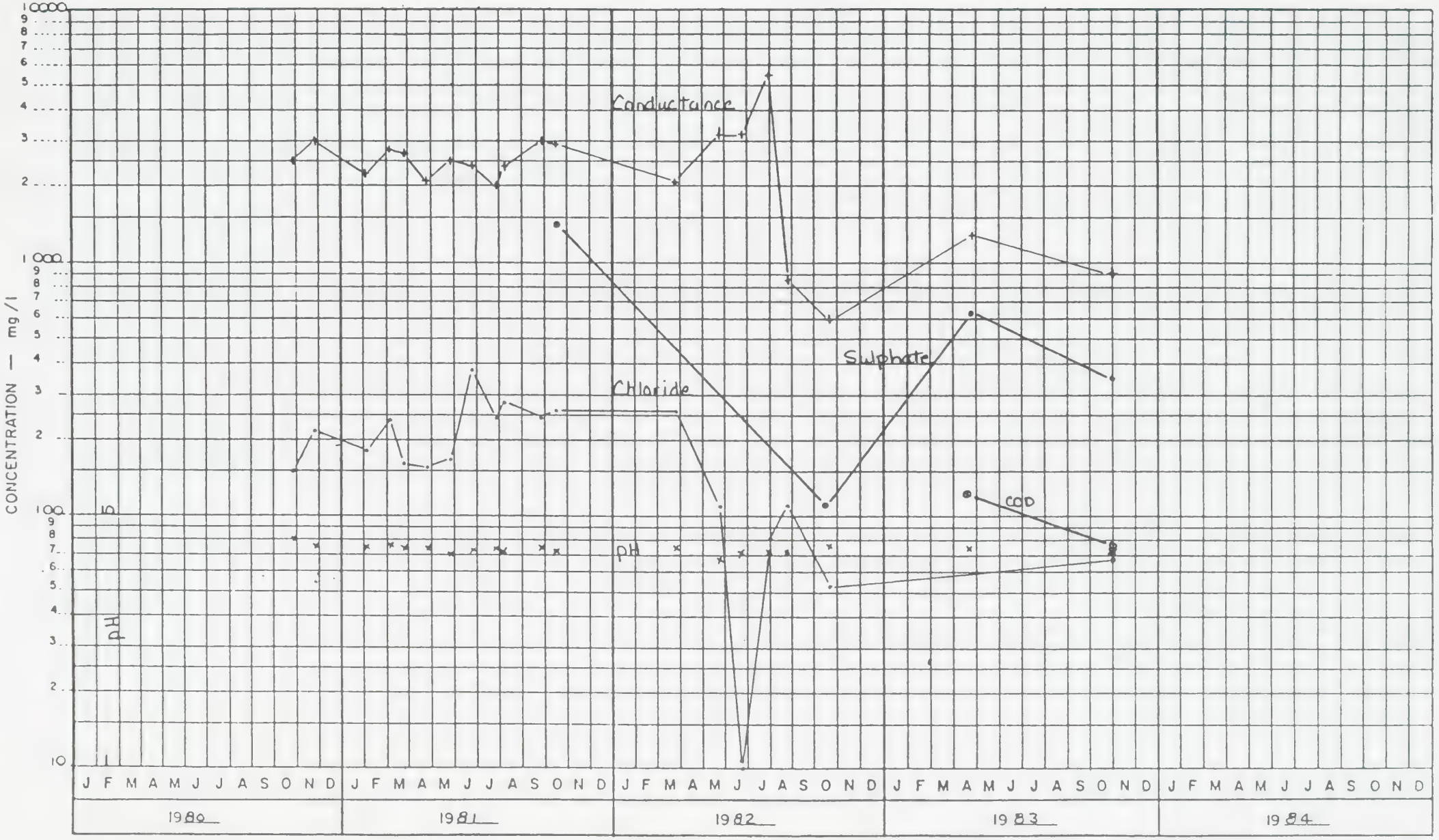
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 14-III



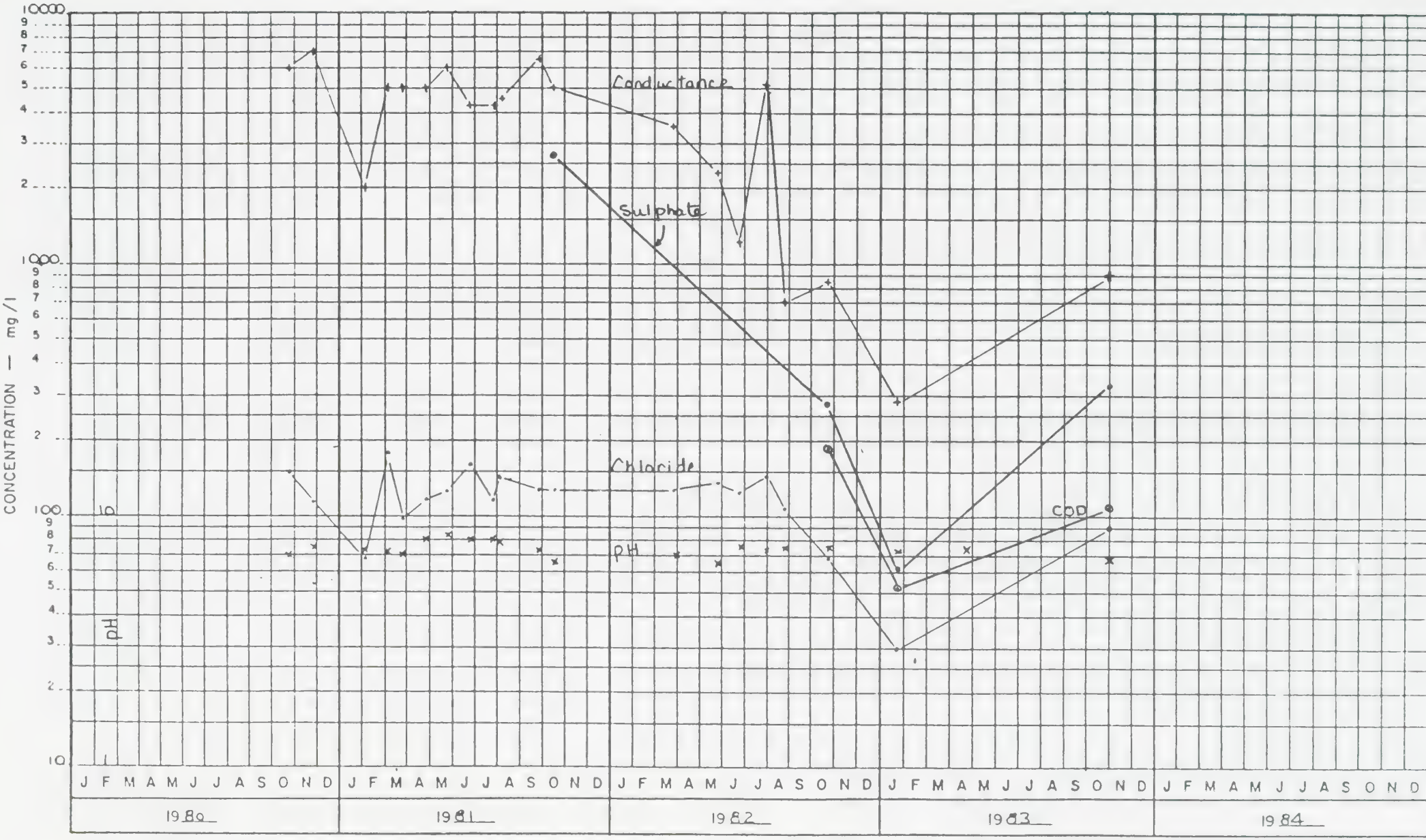
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 22-I



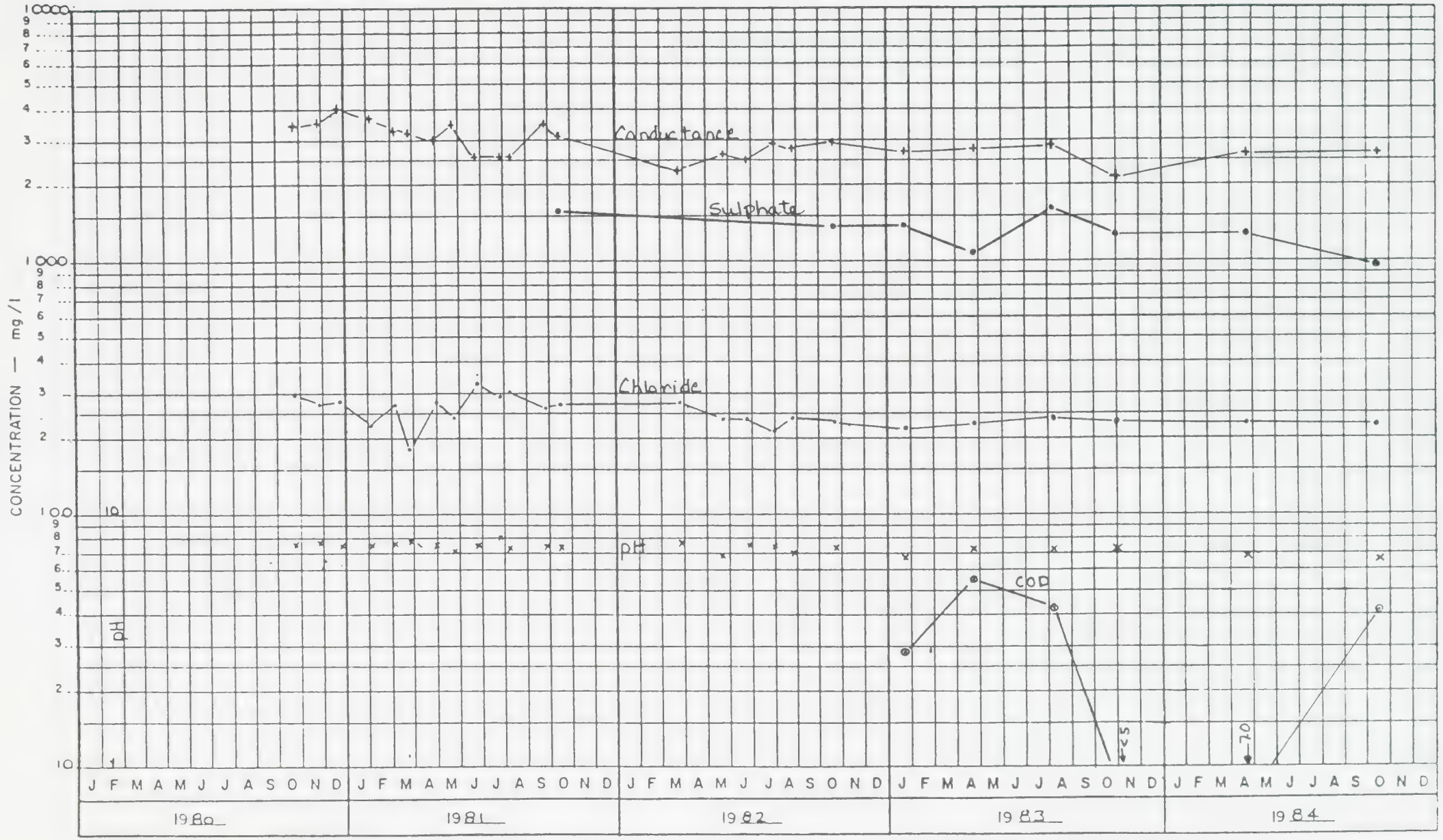
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 22-II



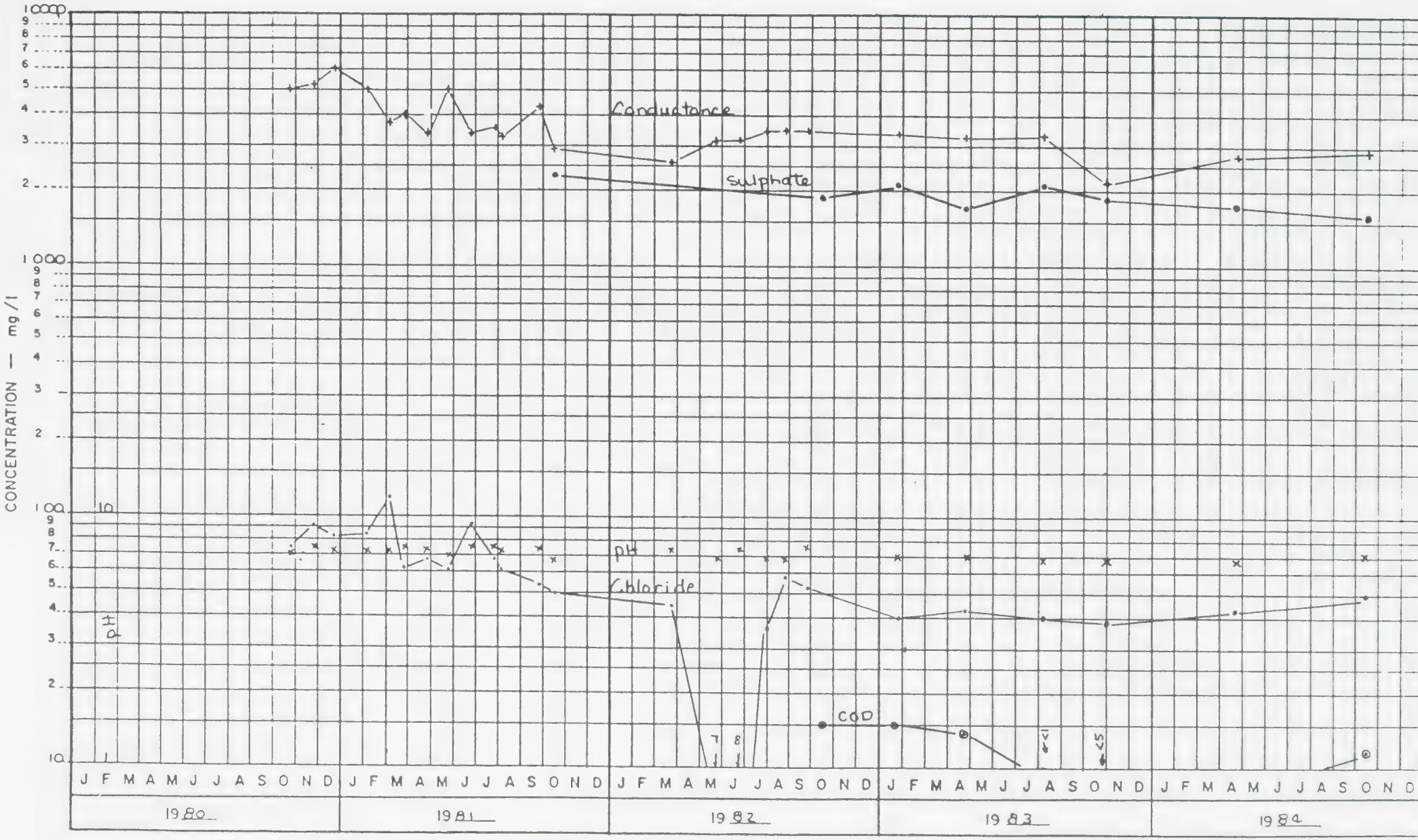
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 24-I



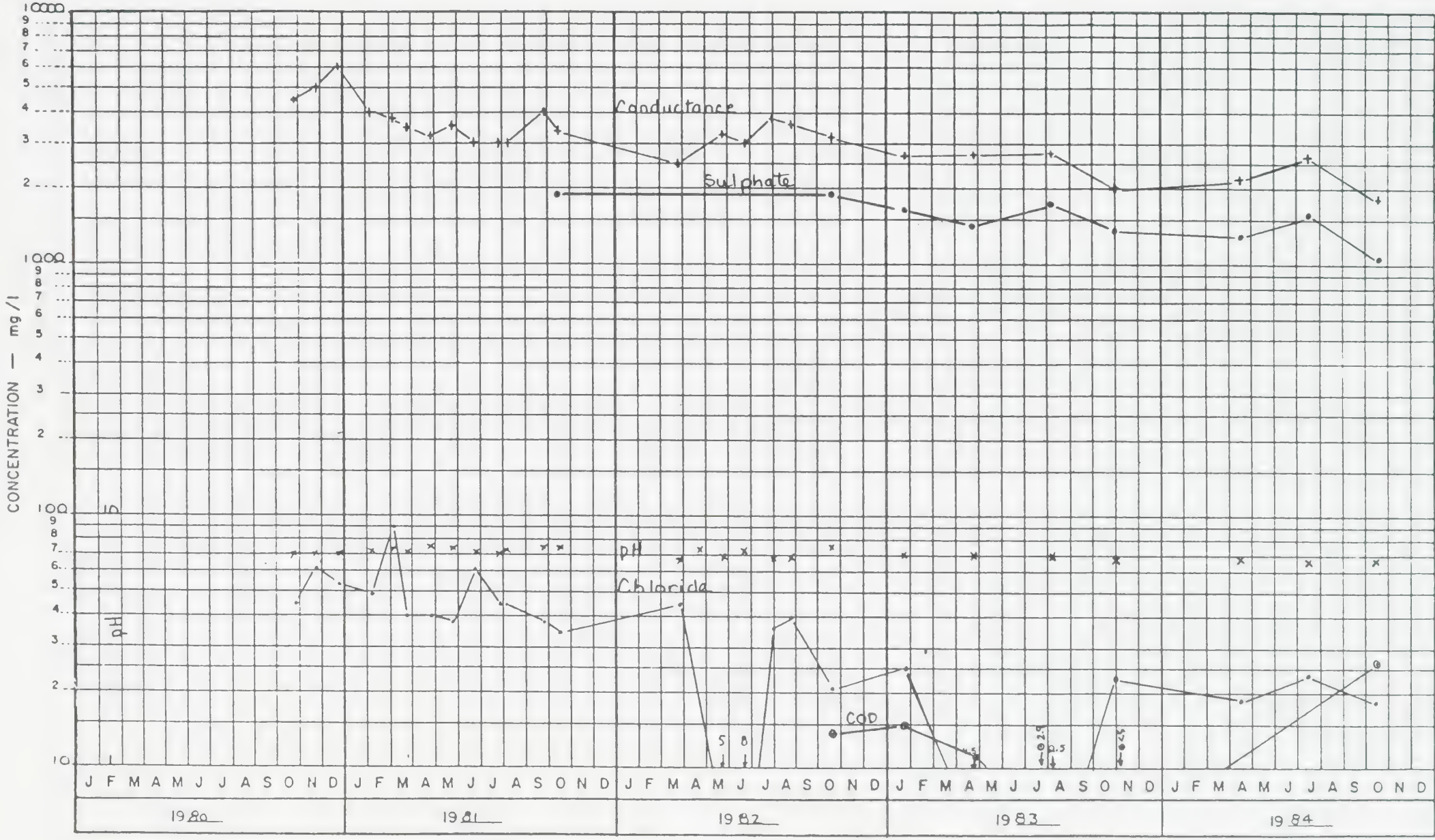
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 24-II



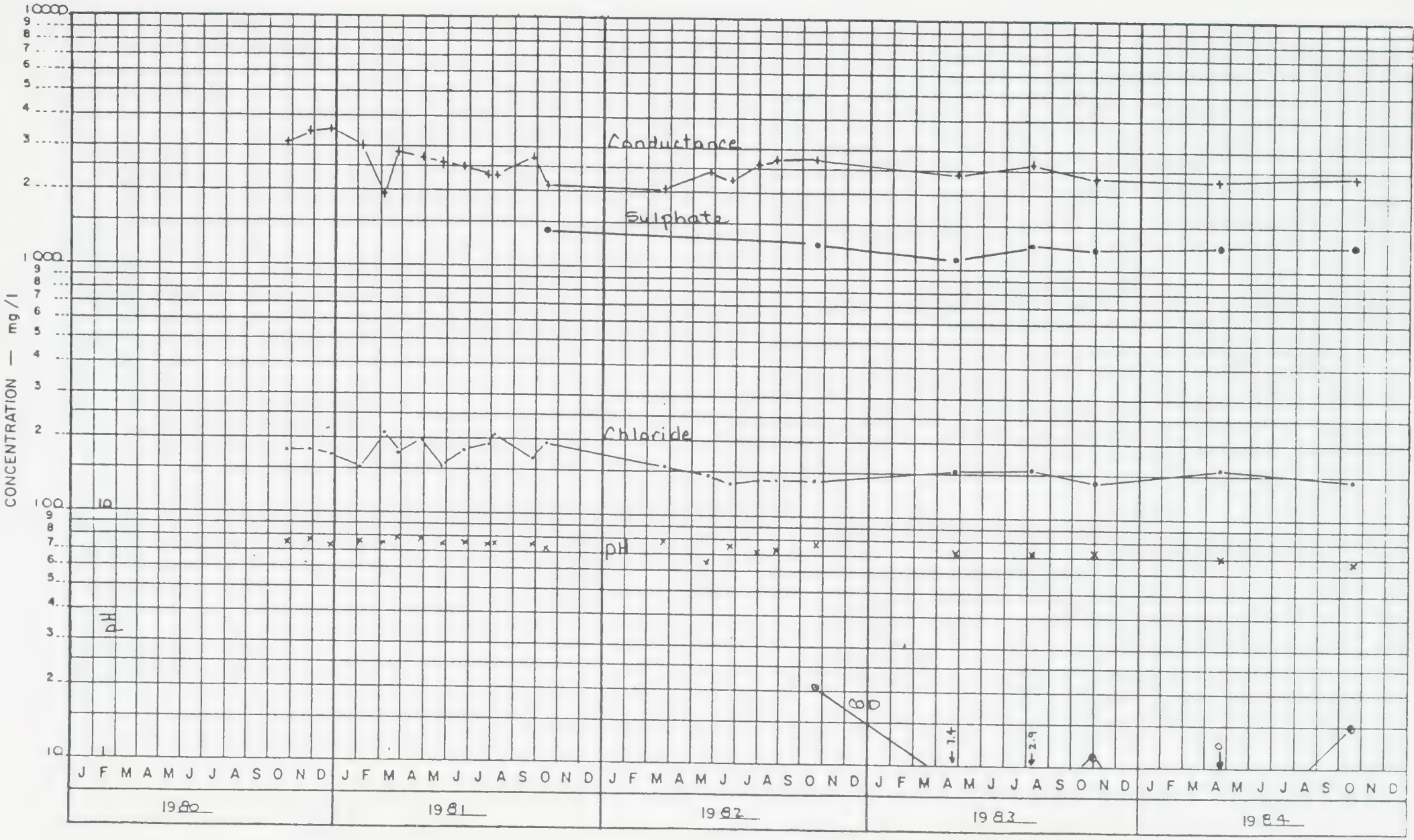
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 24-III



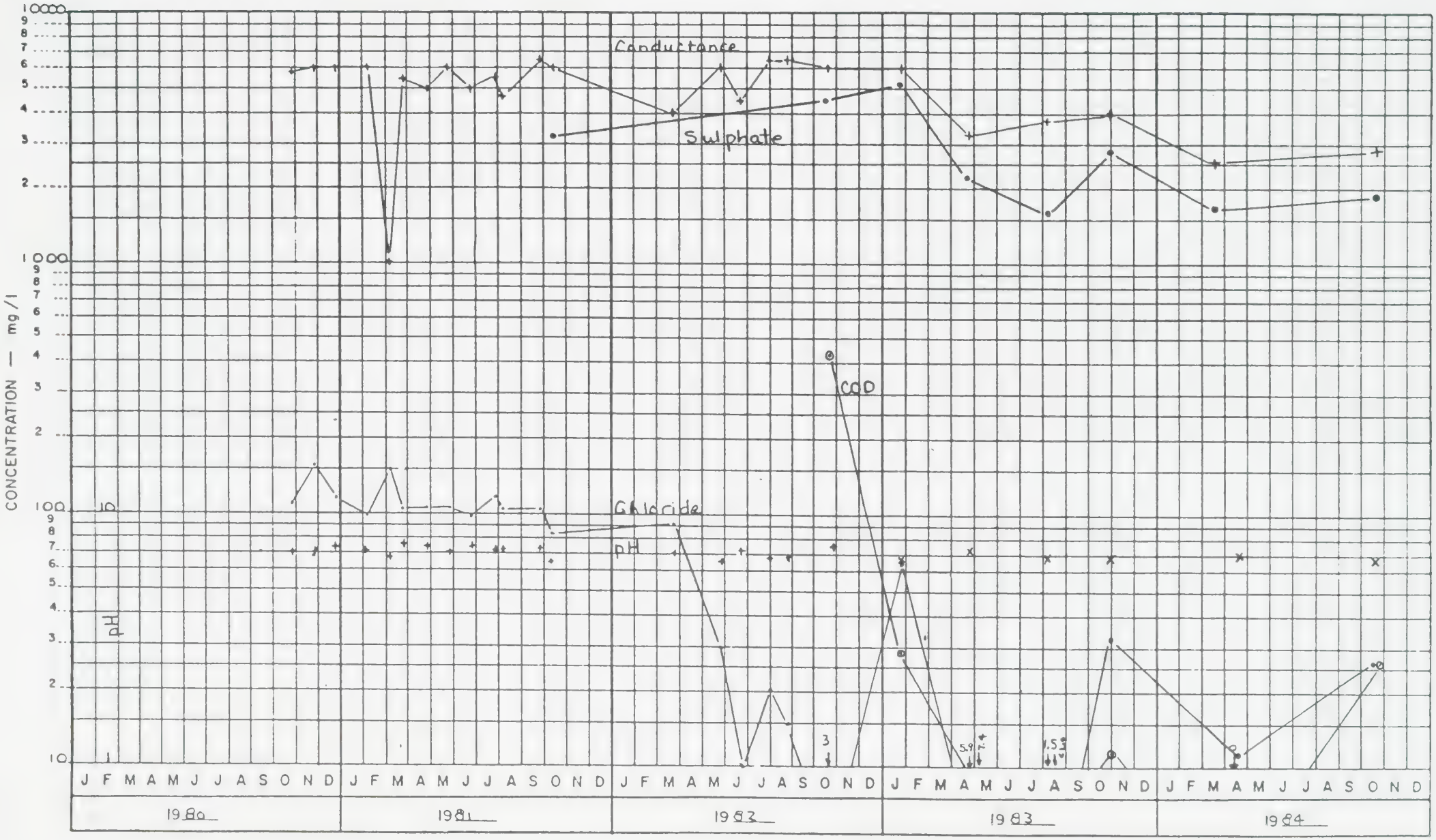
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 25-I



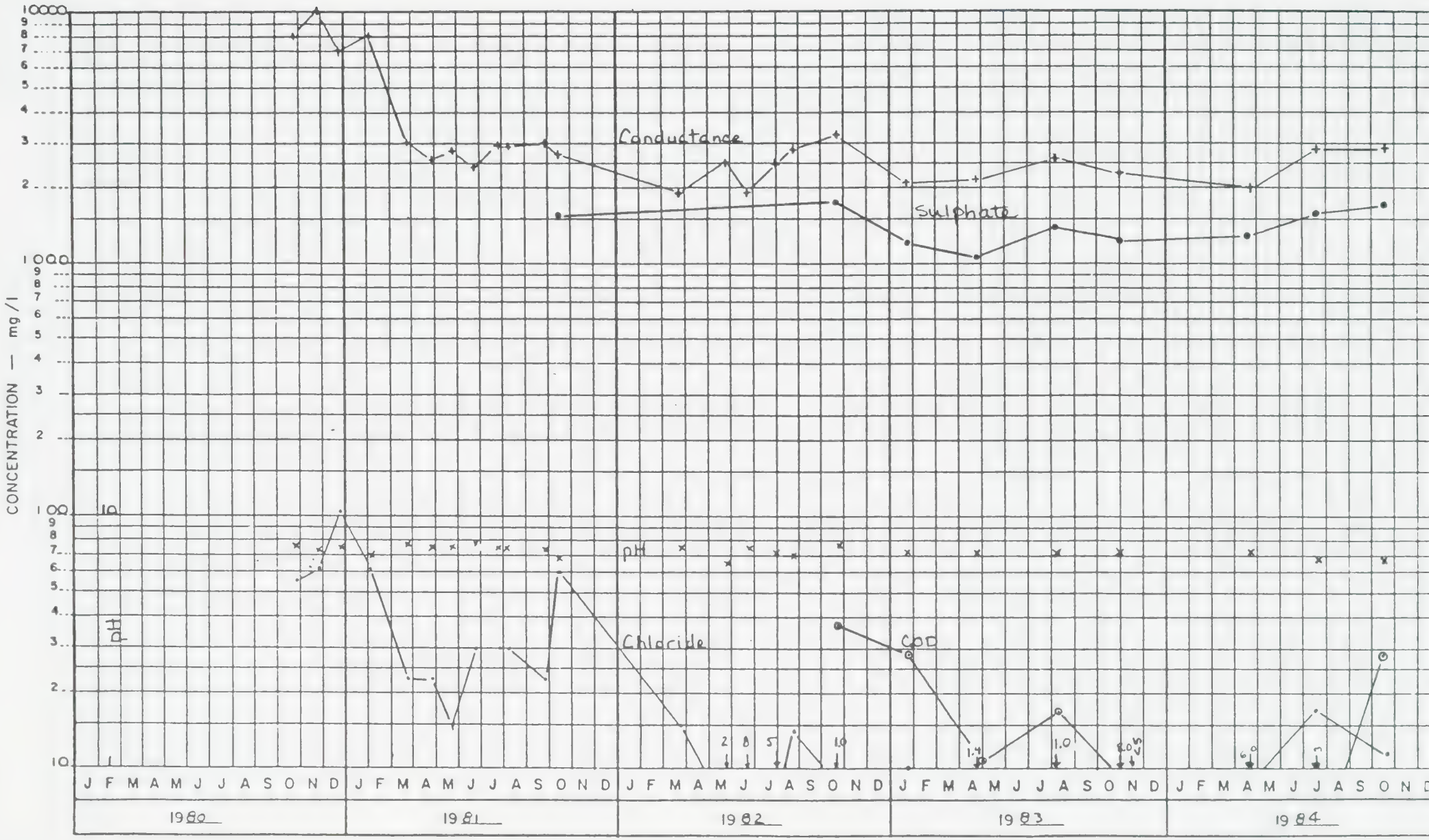
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 25-II



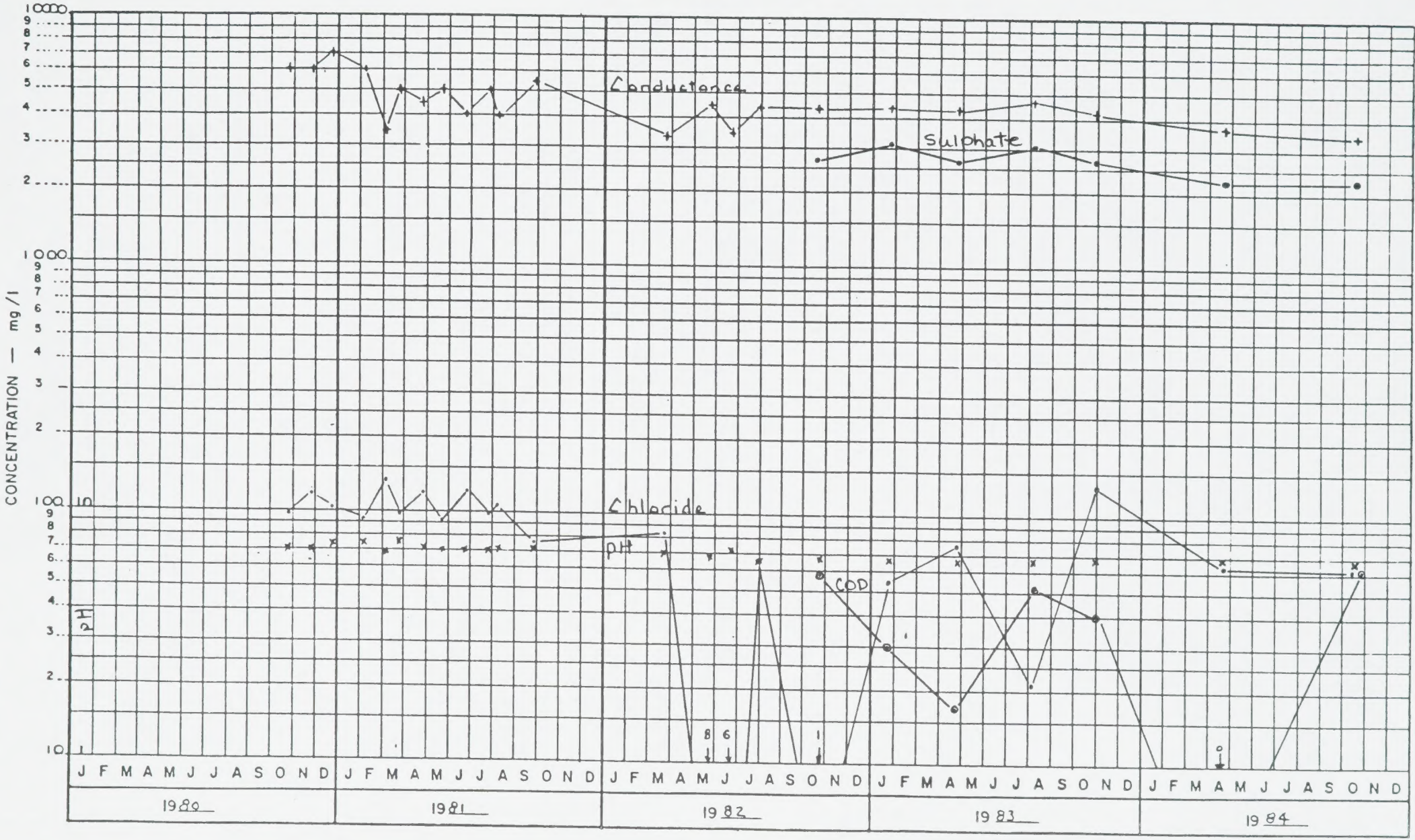
REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 25-III



REGIONAL MUNICIPALITY OF HAMILTON-WENTWORTH
REGIONAL LANDFILL SITE
WATER CHEMISTRY

BOREHOLE 25A-I



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